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ESTIMATING
SPECIFICATION
and LAYOUT
for
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HEATING • VENTILATING
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OCTOBER, 1961

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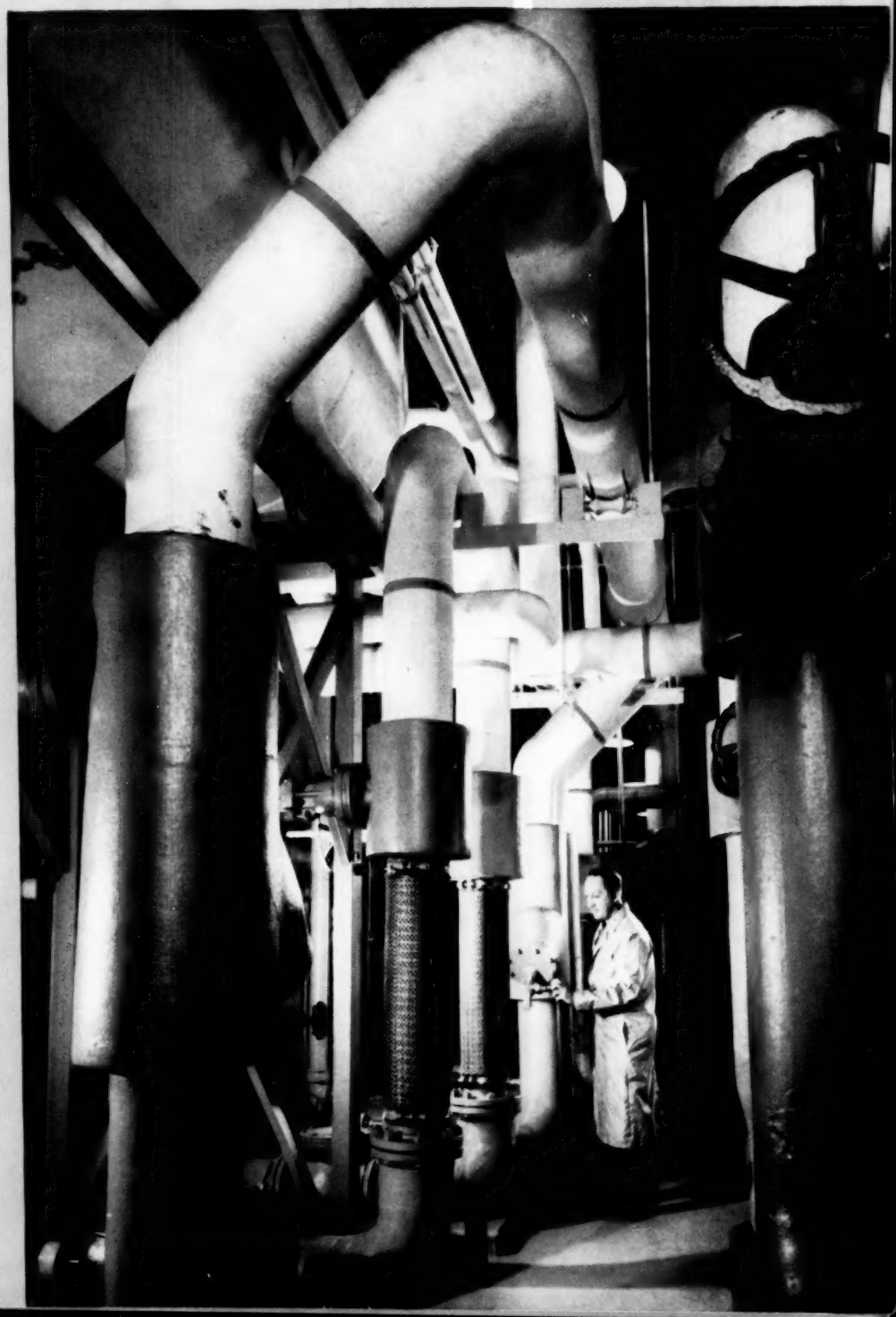
This service area supplies all the utilities and services required by modern semiconductor manufacture. Color-coded lines carry dry air, production gases and demineralized water under superclean production area. Page 102.



The Slade School

New Britain, Connecticut

ARCHITECT: Willard Wilkins, Hartford, Conn.

ENGINEERS: Van Zelm, Heywood & Shadford, West Hartford, Conn.

HEATING CONTRACTORS: Walter Sullivan & Sons, New Britain, Conn.

This fine modern school is equipped with three 17-section H. B. Smith Model 60 cast iron boilers, which burn #6 oil with horizontal rotary oil burners.

An outstanding example of intelligent economy in construction, operation and maintenance

The taxpayers of New Britain, Connecticut are justly proud of their new Slade Junior High School . . . and they're proud of themselves, too. By application of a sound common sense approach, they saved *more than a million dollars* on their original estimate and came up with a school that's become symbolical of fine construction in the New England area.

But their pride goes deeper than the dollar savings on the original plan. They know they've provided for the taxpayers of the future, too, because they've built a school that will be less expensive to operate and maintain. For example, take the heating plant designed by Van Zelm, Heywood and Shadford. The three H. B. Smith boilers, burning economical #6 oil, are not only as efficient as the best, but by reason of their cast-iron construction will never require periodic tube replacement and will last longer than conventional fire tube boilers.

Hence the *FUTURE* taxpayers of New Britain will reap the benefit for many, many years.

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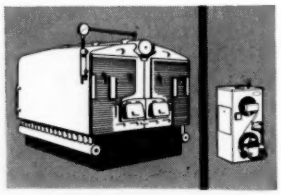
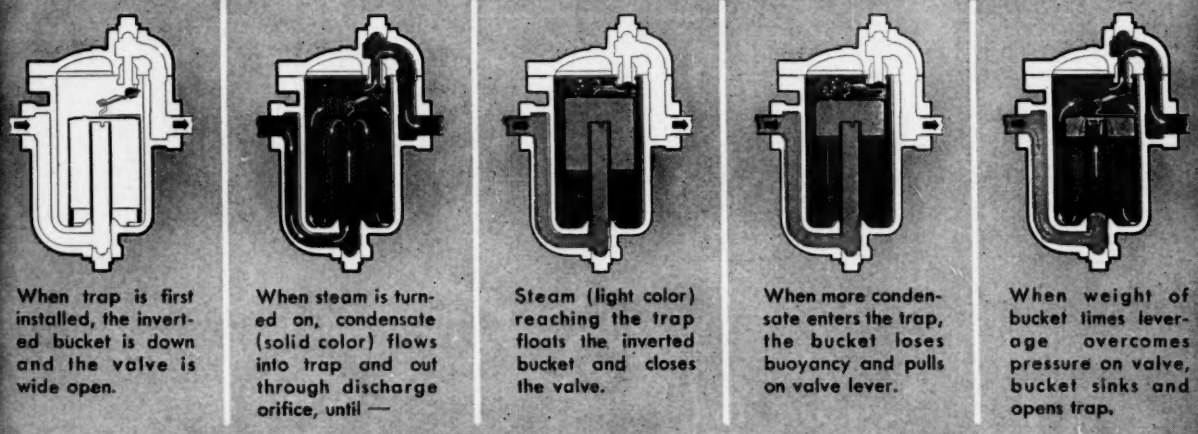
Established 1853



This simple trap operating principle provides the efficiency, dependability and freedom from maintenance necessary for the most profitable use of steam



When trap is first installed, the inverted bucket is down and the valve is wide open.

When steam is turned on, condensate (solid color) flows into trap and out through discharge orifice, until —

Steam (light color) reaching the trap floats the inverted bucket and closes the valve.

When more condensate enters the trap, the bucket loses buoyancy and pulls on valve lever.

When weight of bucket times leverage overcomes pressure on valve, bucket sinks and opens trap.

Key: condensate steam steam bubbles air bubbles

ARMSTRONG INVERTED BUCKET STEAM TRAPS

are designed and made to give you these big benefits:

● Amstrong Traps, the first inverted bucket steam traps, now represent the most advanced development of this time-proven principle. They provide all the advantages necessary for efficient, economical condensate drainage from virtually all types of steam using equipment.

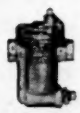
1. *No steam loss* – Steam never reaches the orifice even when there is no condensate load.
2. *Automatic air elimination* – Vent in trap bucket passes air and other non-condensibles through to be discharged with condensate.
3. *No cooling leg required* – Condensate is discharged at steam temperature as fast as it reaches the trap because trap operates on difference in density between steam and water not on temperature.
4. *Operates on any back pressure* – Failure of one trap in system will not cause others to open because high back pressure does not affect an Armstrong trap other than to reduce capacity. As long as there is a pressure differential across the orifice the trap will close on steam and open for condensate.
5. *Unaffected by ordinary dirt* – Swirling action of condensate keeps dirt in suspension until discharged with condensate, prevents it from lodging in valve.
6. *Completely dependable* – Proved design plus the use of all stainless steel working parts assure continuity of service and length of service unmatched by any other trap.
7. *Big capacity in a small, economical package* – Armstrong design gives you the highest practical capacity for any given pressure. And remember, Armstrong capacity ratings are based on *hot* condensate at the *working pressure differential* stated, not on theoretical orifice capacities.

Further information on these advantages plus much additional information is given in the 48 page Armstrong Steam Trap Book. Ask your local Armstrong Representative or write direct.

860 Series for low pressure heating service.

800 Series, side inlet, side outlet.

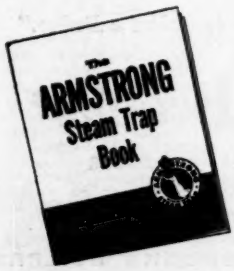
No. 801, side inlet, bottom outlet.



880 Series, integral strainer.

200 Series, bottom inlet, top outlet.

Forged Steel Series for high pressures, high temperatures.



The 48 page Armstrong Steam Trap Book tells how to correctly size, install and maintain steam traps for any pressure, any temperature, any load plus full catalog data on Armstrong Steam Traps. Ask for Catalog K.

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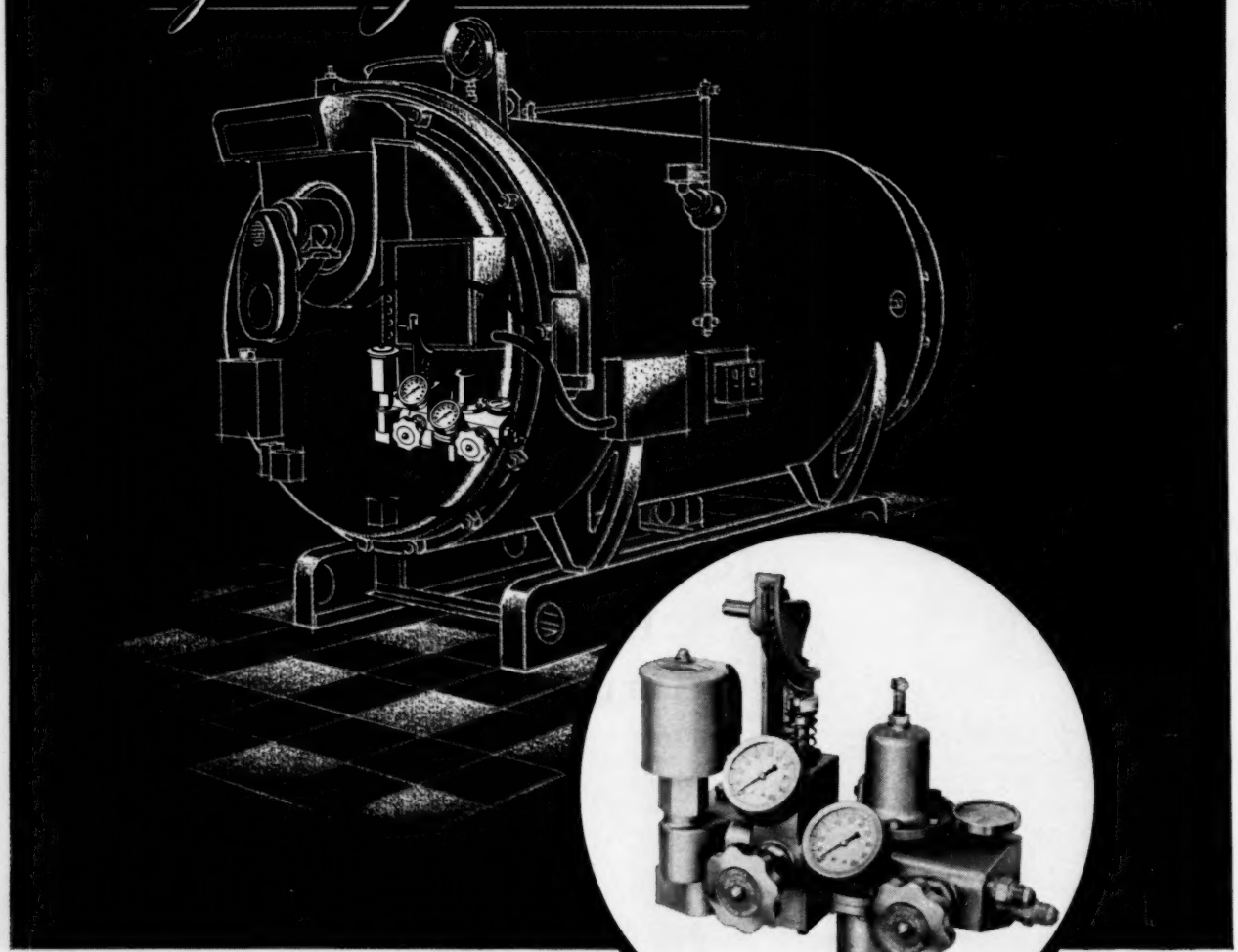

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HIGH SPOTS in this issue

HOSPITAL PLUMBING: Lawrence Guss, a design engineer with Smith, Hinchman & Grylls Associates and co-chairman of the Michigan ASSE Research Committee, has written this month's **Reference Section,** setting down those data which, in the course of his work on hospital plumbing design, have proved most reliable. **Cold and hot water supply, sanitary drainage, and oxygen, vacuum, compressed air, and natural gas systems are covered.** In an appendix to the article, the author proposes a detailed list of **hospital plumbing fixture ratings** and asks his fellow designers and researchers for their comments. Page 71.

SWIMMING POOL DESIGN: Selection of building components to insure the proper thermal environment for swimmers and spectators alike at heated indoor swimming pools is the highlight of this second article on heating and ventilating of pools by Robert Daly and Walter Bishop of Jos. P. Wohlpart Associates. **A chart of inside wall temperatures vs. outside temperatures for various wall U-values** should prove to be of considerable help in advising the architect. Page 63.

OUTDOOR RESET: The primary objective of weather control for hot water heating systems is to adjust water temperature to building heat loss. C. J. Allen, chief engineer, Heating Division, of the Albert Kahn firm, explains how the **curve of water temperature vs. outdoor temperature** can be plotted. Page 91.

CONDENSER COMPREHENSIVE: The **rapid rise in use of remote air-cooled condensers** warrants the close look we are taking at them this month. Our lead-off article, authored by Henry Williams of McQuay, Inc., covers design, application, and control of head pressure for these units. One informative section details refrigerant piping recommendations, seen as the key to well-engineered installations.

THE RIGHT IMPELLER: In the second of four articles on pump selection for air conditioning applications, Henry Pollak of Ingersoll-Rand shows that **low net positive suction head and high efficiency are often incompatible.** The choice of impellers is discussed. Page 67.

ENGINEERING BULLETINS: Some of the nicest people we know are our advertisers, and the wealth of information they have and are willing to share is vast. In order to expedite the transmittal of this information from manufacturer to engineer, we are instituting in this issue a new monthly department. To be called **Current Engineering Bulletins,** this section will list informative, up-to-date bulletins and catalogs which are being offered. If you will turn to page 161, you'll see that this literature is grouped under appropriate headings, and is keyed to the readers' service card in the rear of the magazine.

Do you have an answer for Mr. Quibble?

Changing educational patterns demand flexible schools with learning spaces equipped for year-round air conditioning under unitary control— as an economic necessity based upon educational productivity for the life of the building.

Mr. Quibble is a well-meaning school executive.
He believes in air conditioning and would like to have it in his new school.
But he is apprehensive about the opinions of board members and taxpayers.
So he is apt to forego this basic requirement for maximum learning and
build a school that will be sadly lacking through the coming decades.
Only his architect and engineer can show him how to have air conditioning
with proper regard for economy and without sacrifice of beauty and utility.
The revolution in education is bringing a revolution in schoolhouse design
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Mr. Quibble's quandary is a challenge to your designing skill.
Nesbitt—with a long experience in the school field—offers a
slide film presentation, case studies, cost data, and many other services
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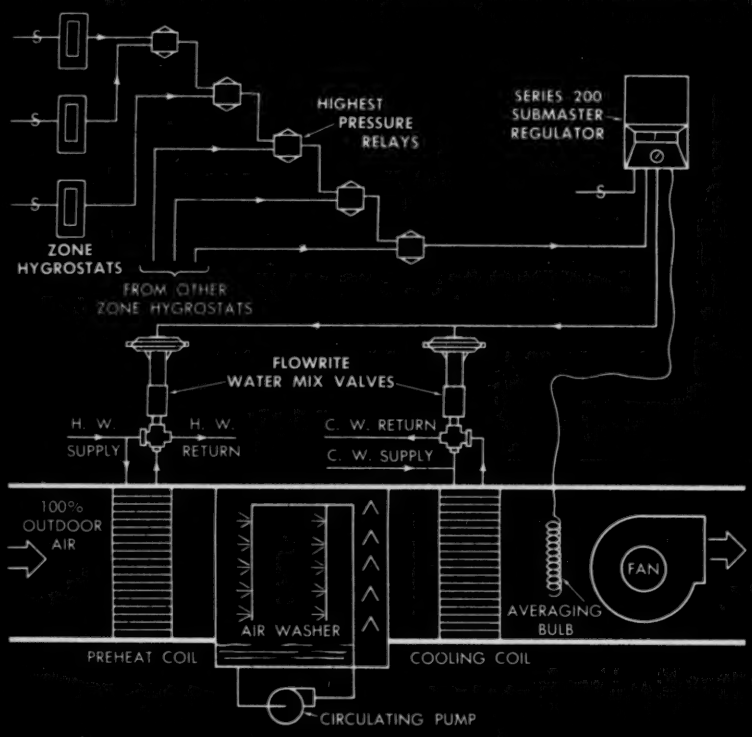
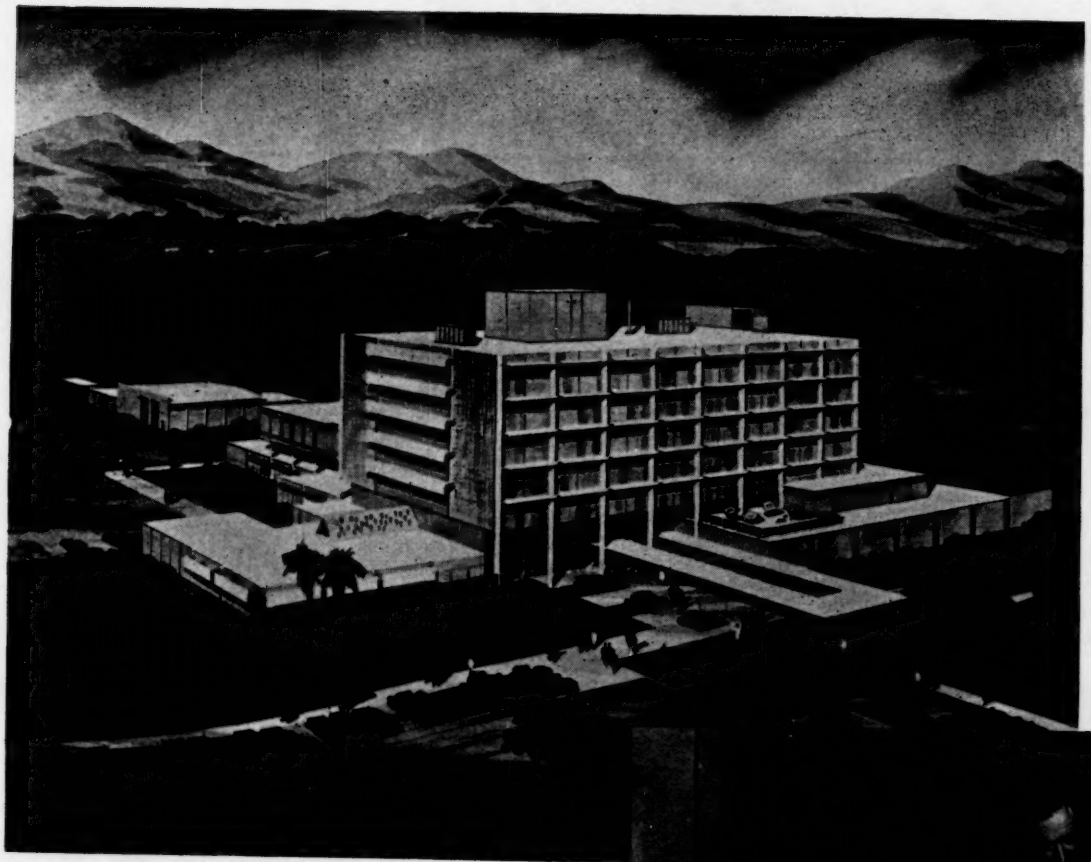
W TO OUT A SPACE SQUEEZE



At Holy Cross — where they automated "just about everything but patient care" — space was even more of a factor than with most hospitals. Money is always a factor.

Consulting engineer, John F. Reardon, was in the middle of the "squeeze", but he had a number of very practical ideas that brought him out with room to spare. One was on humidity control. His practicality in this instance was a central air washer rather than individual zone humidifiers. In terms of space and cost savings, this totaled up in the elimination of water pans and drains, complex piping, steam coils, control valves and numerous access doors.

The central air washer system is proving highly satisfactory. Briefly here is how it works: Room air temperatures are maintained by Powers Thermostats which operate valves on zone reheat coils. Minimum humidity is maintained by Powers Zone Hygrostats signalling through a highest pressure relay cascade. This pneumatic signal resets the control point of



Architects and Associates: Gene Verge and R.N. Clatworthy, Los Angeles, California

Consulting Engineer: J. F. Reardon & Associates, Van Nuys, California

Hospital Consultant: Gordon Friesen, Washington, D.C.

Award-winning Holy Cross Hospital is located in picturesque San Fernando Valley, California

a Series 200 Submaster which in turn operates the valves on either the pre-heat or cooling coil as required. The air washer, located between these coils, operates continuously without addition of heating or cooling to the spray water.

Another important innovation at Holy Cross is private facilities for individual rooms. The shower in each is protected by a Powers Hydroguard Thermostatic Control which prevents accidental scalding and fluctuations in water temperature.

For detailed information on the temperature control system and/or shower control system at Holy Cross request layout drawings and full description. Also ask for reprints describing Powers Control Systems in other institutions.

Heading up the planning staff were (left to right): Consultant, Gordon A. Friesen; Consulting Engineer, John F. Reardon; Architect, Gene Verge; and Administrator For Holy Cross Sisters, Sister Olivia Marie.

The Powers Regulator Company also offers Powers-Grover Pneumatic Tube Systems and Powers Security Alarm Systems. Request literature and recommendations on your requirements.

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CONTROL SYSTEMS SINCE 1891

NEWS OF THE MONTH

SEVEN TOPICS TO BE FEATURED AT BRI FALL CONFERENCES

Seven topics of vital interest to the building industry make up the program for Building Research Institute's 1961 Fall Conferences, taking place this year at the Mayflower Hotel, Washington, D. C., Nov. 28 to 30.

A day-and-a-half meeting (Nov. 28-29) on Prefinishing of Exterior Components will contribute further to the development of information on structural components brought out at the meeting on preassembled components held by BRI in the fall of 1960.

Two and a half days of reports and discussion will be devoted to Performance of Plastics in Building. An array of speakers will present performance experience and data for evaluation and discussion by the conference-at-large.

Occupying a full day of program each will be two more programs, Mechanical Fasteners for Wood (Nov. 29), and Design for the Nuclear Age (Nov. 30). The first presents much-needed information on shear plates, mechanical fasteners for wood diaphragms, trussed rafters and glue-nailed construction. Design for the Nuclear Age will deal with fall-out protection in various types of buildings.

In an effort to achieve better communication about, as well as better description of colors, there will be an exploratory program on Identification of Colors for Building, featuring three experts on various aspects of color design and a panel discussion by architects, builders and others from the industry.

Another half-day session, of interest particularly to owners and operators of commercial and industrial buildings, is the program on Methods of Building Cost Analysis, which will be offered on Tuesday, Nov. 28, and will present methods used by some of the nation's top firms.

Finally, the BRI Research Committee will again present one of its increasingly popular roundups of widely varied aspects of building research. Conference attendants will hear reports on new research projects just getting under way, results of recently completed projects, and reports on research in other fields that has real importance for the building industry, but which otherwise might be completely overlooked in the flood of scientific information pouring out today.

Attendance at the Conferences is not limited to BRI members. Non-members wishing to participate should write for advance registration materials to BRI, National Academy of Sciences-National Research Council, 2101 Constitution Ave., Washington 25, D. C.

Cost of Solar Heating for New England Home Is Still too High, MIT Experimenter Reports

Sunshine hitting its roof can at present provide a three-bedroom suburban house in New England with two-thirds of the energy required for heating and domestic hot water supply. To do better than this would be feasible, but to attain total solar heating in the random weather of New England requires more storage space than is convenient in a small house. And, under present market conditions, the cost of mechanical equipment required for solar heating remains higher than can be justified by fuel savings.

These are some of the conclusions reached after three years of operation of Solar House IV, in Lexington, Mass., by Massachusetts Institute of Technology. They were reported by Professor Albert G. H. Dietz at the United Nations Conference on New (Non-nuclear) Energy Sources in Rome, Italy. Dr. Dietz is professor of civil engineering and a member of the Space Heating Committee of the MIT Solar Energy Conversion Project.

Solar House to Be Sold

Built in 1958 specifically for experimental work in solar energy, the house has yielded all the scientific information it can provide and will now be converted into a conventional home and sold, Professor Dietz said.

The most valuable contribution of the house, he reported, was the engineering knowledge gained in constructing and operating a complex solar heating plant. "Somewhere and sometime this knowledge will be a resource," he said. "In countries where conventional fuels are abundant, the use of solar energy for heating is economically attractive only where the climate permits an unusually high yield of sunshine per square foot."

Mechanical Features Described

Architecturally, the most striking feature of the house was the solar energy collector which formed all of the combined roof and wall of the south side of the building. Set at an agle of 60°, the 16-by-40-ft collector consisted of two layers of glass over an identical area of thin aluminum sheet painted black. Water pumped through copper tubes attached to the aluminum sheet was heated by trapped solar energy and then stored in a 1500-gal tank in the basement. Hot water from the tank was pumped through a heat exchanger to transfer heat from the water to air. The warm air

(Continued on page 10)

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MAX. INITIAL PRES. PSI	200	250	250	250	250	250	250	300
MAX. REDUCED PRES. PSI	15	80	125	125	15	125	125	180
MIN. REDUCED PRES. PSI	1	5	5	15	2	5	2.5	5
STEAM SERVICE								
WATER SERVICE							*	
AIR SERVICE							*	
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OIL SERVICE								
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DEAD END SERVICE								

*When specified, diaphragm must be changed from phosphor bronze to rubber.

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SOLAR HEATING

(Continued from page 8)

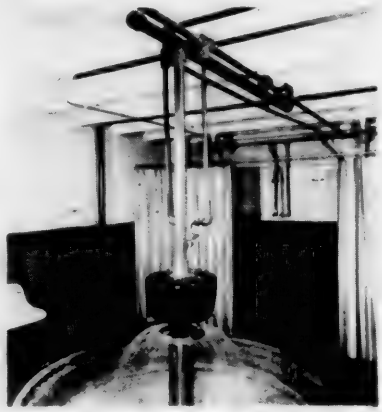
was forced through ducts to heat the house, as in conventional heating systems. Incoming cold water from the public water system was heated for domestic hot water supply by being pumped through coils in the storage tank.

In operation, temperatures within the house were very strictly maintained and the occupants at no time accepted any compromise with the comfort levels or volume of hot water use that Americans have come to expect, Profesor Dietz said. The house was occupied by the chief engineer of the project, Claremont D. Engebretson, former MIT research associate in mechanical engineering, and his family.

During the three-year period, Engebretson kept a detailed record of performance of the system and gradually improved the installation until, in the 1960-61 winter, the heating plant operated at peak efficiency and satisfied the predictions of its designers.

Professor Dietz noted that the flow of controlled energy in the Solar House system was distributed on a fully automatic basis. Regulating devices instructed the system exactly when energy could be picked up from the sun at the collector-roof and told the auxiliary fuel-burning heater precisely how long to wait before coming to the aid of a depleted store of solar energy.

To accomplish this required a greater complexity of piping, valves, pumps and especially control devices than is ordinarily found in a small building, and maintenance of such a system is also an economic factor in solar heating. The experience gained in coordinating these elements into a complete system capable of the most careful custody of small amounts of energy is the most profitable result of building and operating the house, Professor Dietz reported.



Three plastics are used for piping in employee washroom. Cold water lines, including ¾-inch ball valve (upper right) and vent in center are UPVC. Hot water lines include chlorinated polyether (Penton) leading to the wash basin and polyvinyl dichloride (hi-Temp Geon) leading to the shower stalls in background.

Solar Air Conditioning Sought

Although the Lexington house is the first complete suburban house built by MIT, it is officially Solar House IV—the fourth in a series constructed since 1938. The first was a two-room office and laboratory building built on the Institute's campus to establish the principles of design of the flat plate collector of the type used in the Lexington house.

The second solar house was a small laboratory building, also on campus, which was later extensively remodeled into a home for a married student and his family. Completed in 1948, Solar House III was occupied by a succession of student families for nearly a decade and yielded much of the information used in designing the solar heating plant of the Lexington house.

Two problems that can be studied without experimenting with a full scale house are the next research projects of the MIT Solar Energy Conversion Project, according to Prof. Lawrence B. Anderson, professor of architecture and chairman of the project's Space Heating Committee. The first involves investigating new combinations of materials for the construction of less expensive collectors able to withstand stresses of temperature and weather. The research group will also try to devise cooling equipment, operating on solar energy, so that summer sunshine can be utilized for air conditioning.

Solar energy research at MIT is financed by a grant from Godfrey L. Cabot, prominent Boston industrialist, MIT alumnus ('81) and member of the MIT Corporation.

(More news on page 138)

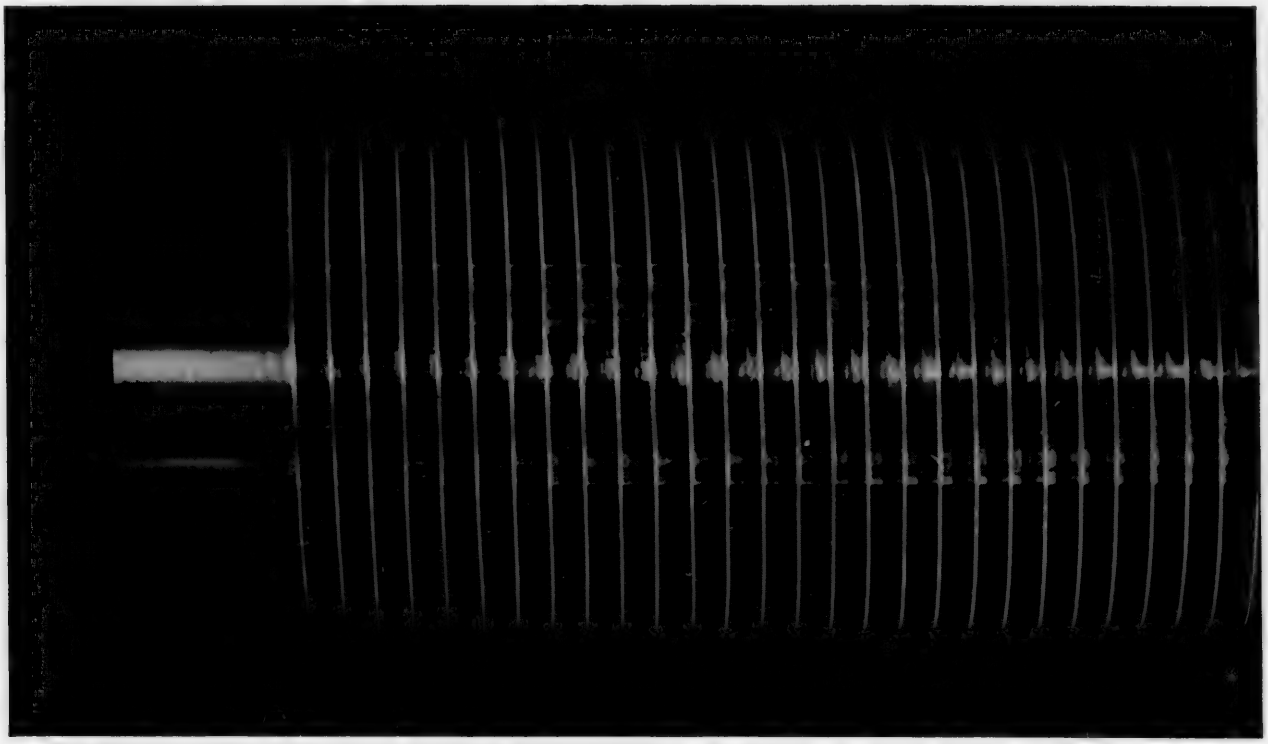
LEAK-FREE FIRST YEAR PASSED BY PLASTIC HOT-WATER PIPING

An all-plastic piping system of hot water, cold water, waste drainage and vent lines is reported having passed its first year of leak-free, maintenance-free use at the Louisville plant of Tube Turns Plastics, Inc.

The Chemetron Corporation affiliate used a new employee washroom in its own plant as the test location for a type of plastic pipe installation that the company sees as the forerunner of new home and building construction.

Unplasticized polyvinyl chloride (UPVC) was used for all cold water and waste drainage lines and vents. Two newer thermoplastics for high-temperature service—chlorinated polyether ("Penton") and unplasticized polyvinyl dichloride (hi-Temp Geon)—were used for hot water lines to showers and wash basins. Pipe sizes range from ½ to 4 inches and both socket and threaded connections were used for dual test purposes. Hot water temperatures up to 165 deg F and full city water pressure up to 100 psi, are encountered.

State board of health approval was obtained for the trial installation, which has been in use around the clock since it was installed as part of a mid-1960 plant expansion program.



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Lower Airway Resistance
—less power per c.f.m.

Aerofin smooth fins can be spaced as closely as 14 per inch with low air friction. Consequently, the heat-exchange capacity per square foot of face area is extremely high, and the use of high air velocities entirely practical. Tapered fin construction provides ample tube-contact surface so that the entire fin becomes effective transfer surface. Standardized encased units arranged for simple, quick, economical installation.

Write for Bulletin S-55

AEROFIN CORPORATION

101 Greenway Ave., Syracuse 3, N. Y.

Aerofin is sold only by manufacturers of fan system apparatus. List on request.

The refrigerants you want... packaged the way you want them! Take your pick!

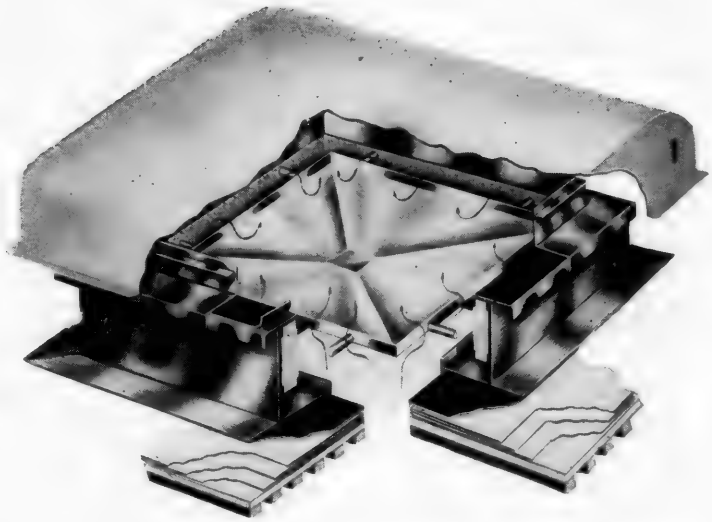
genetron 11 CCl_3F ORANGE LABEL TRICHLOROMONOFLUOROMETHANE
genetron 12 CCl_2F_2 WHITE LABEL DICHLORODIFLUOROMETHANE
genetron 22 $CHClF_2$ GREEN LABEL MONOCHLORODIFLUOROMETHANE
genetron 113 $C_2Cl_3F_3$ PURPLE LABEL TRICHLOROTRIFLUOROETHANE
genetron 114 $C_2Cl_2F_4$ BLUE LABEL DICHLOROTETRAFLUOROETHANE

NEW! Get facts about "Genetron" 11 solvent in special pressurized cylinders for cleaning out mildly contaminated systems following burnout.

Allied Chemical

GENERAL CHEMICAL DIVISION
40 Rector Street, New York 6, N.Y.

FORGET WATER DAMAGE FOREVER



The ULTRA SONOTROL CURB*

Now, there is no need to compromise the many advantages of exhausting or supplying air through roof mounted, powered and/or gravity ventilators because of possible leaks. Before the development of the ULTRA SONOTROL Roof Curb every hole provided for a ventilator opening was a potential trouble spot.

If you want to get air in or out an opening is required. Our nearly 35 years in designing, manufacturing and marketing roof ventilators has taught us no matter how protected that opening may be, it cannot be 100% watertight under every conceivable condition of wind, storm and weather.

The ULTRA SONOTROL fills the breach. Its exclusive Storm Shield serves as a built in drip-pan. Hurricane gales cannot drive moisture in to water stain ceilings and to buckle or warp wooden floors and joists. The Ultra Sonotrol effectively attenuates sound and with a minimal pressure loss. It also has all the advantages a factory fabricated roof curb has over the uncertainness and expense of field construction.

The curb and ingenious Storm Shield make the best uses of corrosion free fiberglass and aluminum. All water particles that may enter gravity or powered ventilators or fresh air intakes are trapped by the Storm Shield. Water is held until evaporated or passed to the roof through an optional drain tube. No part of the assembly projects below the roof deck to interfere with structural supports.

Read more about this latest Penn Ventilator engineering achievement and how you can eliminate the risk of water damage during severe and extreme weather periods. Send for your copy of Bulletin SC-90 today.

**Fully Protected By Patents Pending*

PVC

PENN VENTILATOR CO., Inc.

PHILADELPHIA 40, PENNA.

A leading manufacturer of Powered and Gravity Roof Exhausters and Accessory Equipment for over 30 years.

Member of AMCA

Penn Ventilator products are available throughout the Free World.
One of many direct factory representatives at your service:
J. R. DOWDELL & COMPANY, THROUGHOUT TEXAS

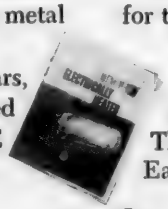
FIRST PRE-PACKAGED

electric storage water heater for commercial, industrial and institutional use.

The new P-KW is the first electric storage water heater to be offered as a standard package unit. It is shipped fully wired, insulated and factory tested. It requires only electrical and water connections to place in operation.

The new unit is equipped with immersion heater, control thermostat, magnetic contactors, circuit breaker, panel control box, ASME temperature and pressure relief valves, thermometer, pressure gauge, metal jacketed insulation, and integral support skids.

Made by P-K on a custom basis for many years, P-KW Electric Storage Water Heaters are designed and fabricated in accordance with the ASME Code and Federal, State and local regulations.

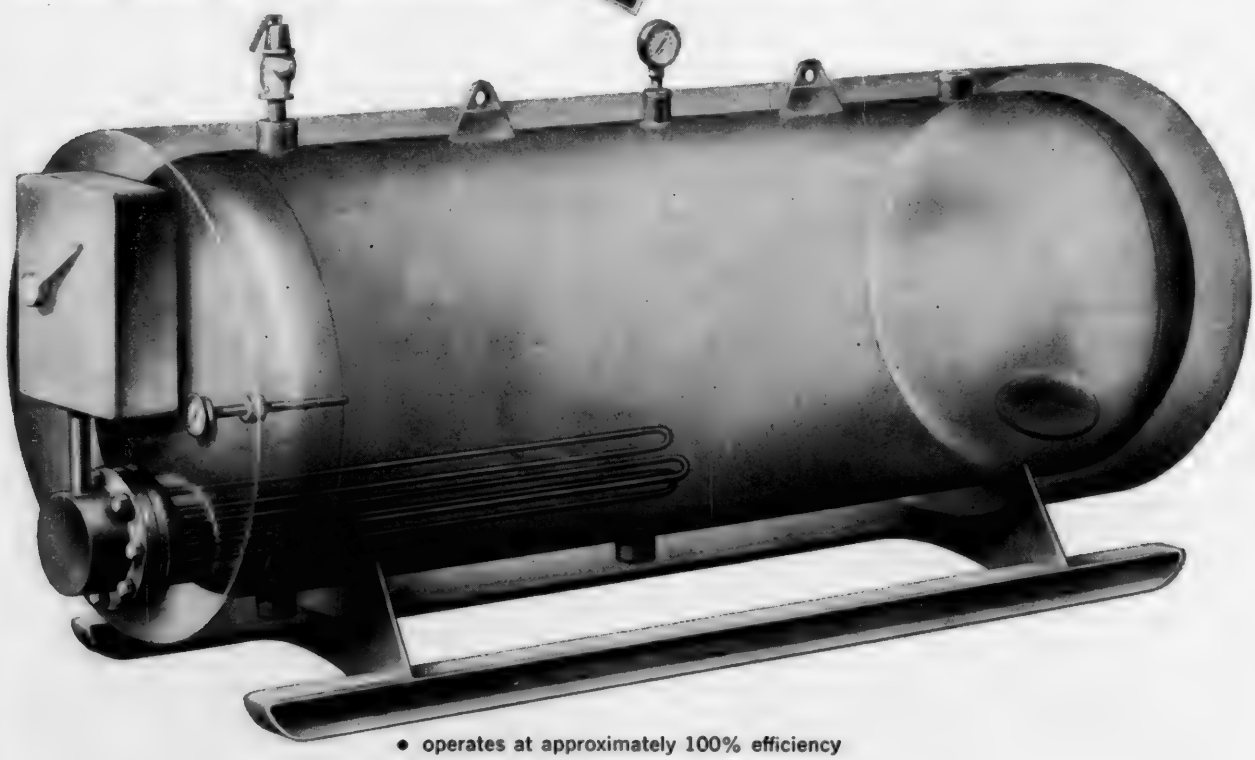


Components that comprise the electrical system, including wiring, meet the requirements of Nema standards and the National Electrical Code.

The immersion heating elements are operated approximately 10 per cent below their voltage capacity—assuring long, trouble-free service. The thermal conversion approximates 100 per cent efficiency.

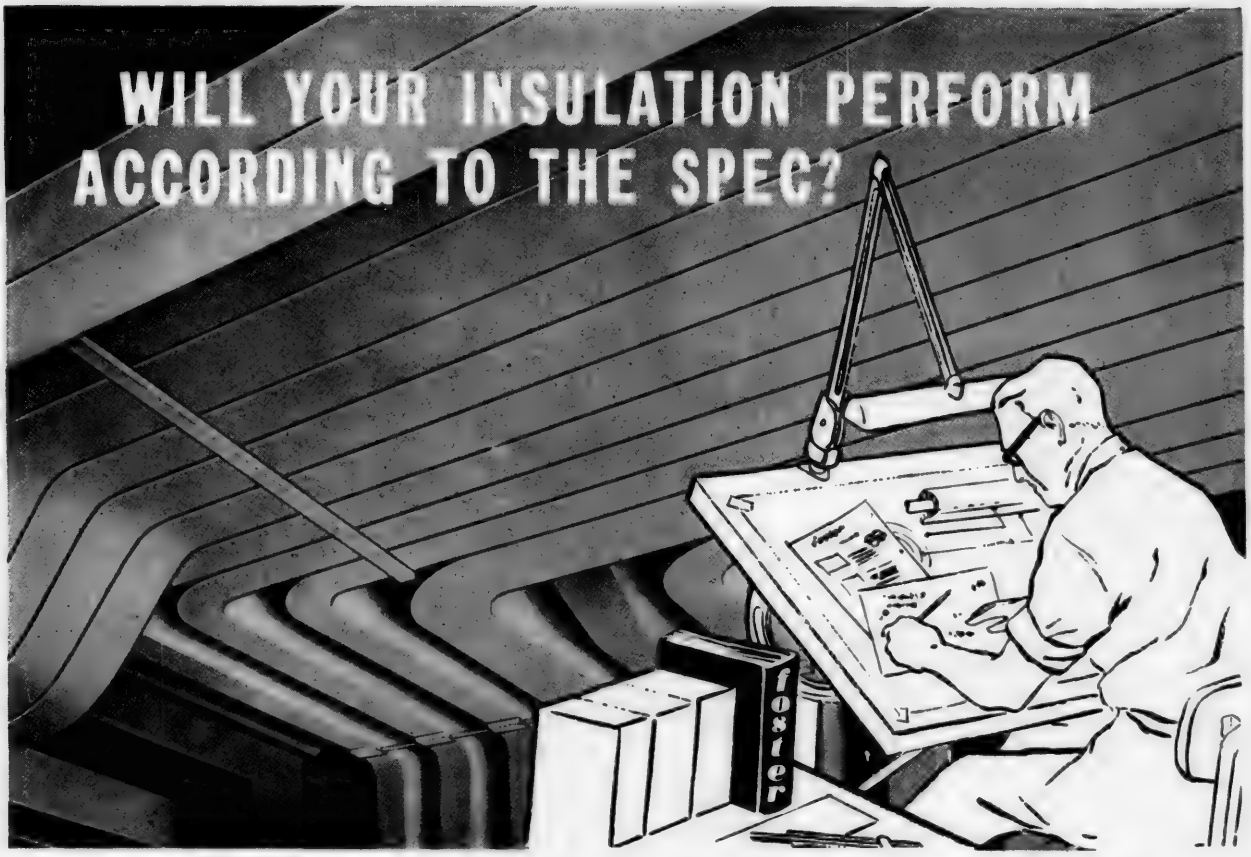
Pre-packaged P-KW water heaters can be selected for three working pressures – 100, 125, and 150 psi.

WRITE FOR CATALOG NO. P-KW-1: contains diagrams, specifications, complete engineering and performance data. Address your request to: The Patterson-Kelley Co., Inc., 210 Morgan Avenue, East Stroudsburg, Pa.



- operates at approximately 100% efficiency
- storage capacities from 284 to 1,300 gallons
- recovery capacities from 41 to 410 gph
- horizontal or vertical design
- safe, silent, automatic

Patterson Kelley



there's a foster protective system to help make sure it will

When the thermal-insulation specification includes the name "Foster," you're assured a protection system engineered to resist practically every condition the insulation can be expected to encounter. And only with the proper protection will the insulation perform efficiently.

There's no such thing as "or equal" when it comes to protecting your costly investment in insulation. Only the Foster system in the specifications can be relied on 100% to fill the bill.

Foster insulation-protection research has developed adhesive, vapor-barrier, and coating systems to meet virtually every conceivable thermal-insulation requirement. A letter or call outlining your problem will bring one or more Foster Bulletins which should contain an appropriate solution.

Thermal Insulation Protected By foster Fire Resistive Specifications

A symbol of fire resistive construction

ARE YOUR SEALED DUCTS FIRE-SAFE?

SPECIFY *foster* 30-02

FIRE-RESISTIVE HIGH-VELOCITY DUCT SEALER

COATINGS, SEALERS, ADHESIVES FOR THERMAL INSULATION

BENJAMIN *foster* COMPANY

Division of Anchem Products, Inc.

4635 WEST GIRARD AVE.—PHILADELPHIA 31, PA.

Milady's Fan is just about the *only* fan you won't find in the complete Ilg line. So why go to the expense and bother of getting a propeller fan from one source . . . roof fans from another . . . centrifugals from a third? Ilg has them all . . . complete selection *within* each category, too.

And regardless of the Ilg fan you pick, you can be sure of performance as maintenance-free as a fan can be. Careful dynamic balancing of all component parts . . . plus electronic checks of Ilg-built motors and Ilg-patented Type "Q" propeller fan and centrifugal fan wheels . . . makes certain that smooth, vibration-free operation is as much a part of the product as the Ilg "One-Name-Plate" pledge of performance.

HERE'S ONE OF THE FEW FANS YOU CAN'T GET FROM

BE RIGHT . . . WRITE IN

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YOUR CHOICE OF CENTRIFUGAL FANS...

Ilg BC Airfoil Centrifugals. Direct-connected and belted types. Aluminum wheel and housing. Single and double width. WRITE FOR BULLETIN DB2-100.

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Ilg BU and FU Util-A-Sets. Belt drive. Forward curved wheel and backward blade types. Capacities up to 23,000 CFM. WRITE FOR BULLETIN DB2-200.

Ilg Type B Direct-Connected and Type FU Belted Util-A-Sets. Forward curved wheels. Capacities up to 2400 CFM. WRITE FOR CATALOG DB2-306.

PROPELLER AND CENTRIFUGAL ROOF FANS...

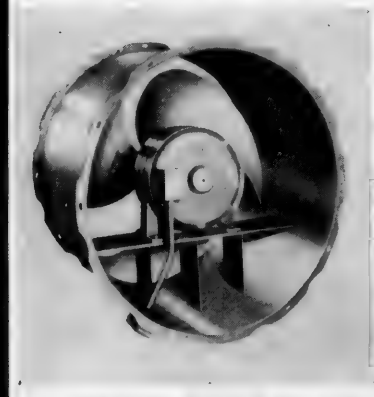
Ilg UB Upblast Roof Ventilators with butterfly dampers. Direct-connected. Airfoil blades. 5 sizes. WRITE FOR BULLETIN DB3-300.

Ilg L-CRF Airfoil Centrifugal Fan Roof Ventilators with patented pressure-cooled direct-connected motor. 15 sizes. WRITE FOR BULLETIN DB3-200.

Ilg L-LSQ Propeller Fan Roof Ventilators. Direct-connected. Type "Q" wheel. 11 sizes. WRITE FOR BULLETIN DB3-100.

Ilg Type CWF Airfoil Centrifugal Wall Exhausters. Direct-connected, pressure-cooled motor. 5 sizes. WRITE FOR BULLETIN DB3-200.

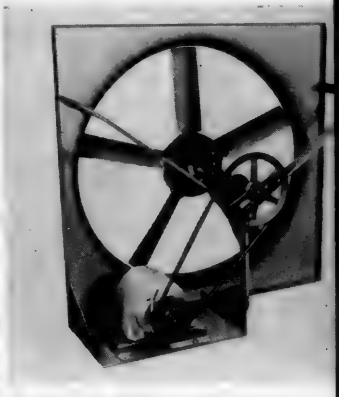
DIRECT-CONNECTED AND BELTED PROPELLER FANS



Ilg TA Tubeaxial Propeller Fans. Direct-drive. 3-blade and 5-blade design. Totally enclosed motors. 8 sizes. WRITE FOR BULLETIN DB1-100.

Ilg PF Square Panel Propeller Fans. Direct-connected, self-cooled motors. Airfoil design and Type "Q" blades. WRITE FOR BULLETIN DB1-106.

Ilg LQ Propeller Fans. Direct-connected. Self-cooled motor. Patented Type "Q" wheel. WRITE FOR BULLETIN DB1-100.



Ilg Type PFB Belted Propeller Fans. 5-blade airfoil design. Totally enclosed motors. 3 sizes. WRITE FOR BULLLETIN.

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Offices in 60 Principal Cities
Member of Air Moving and Conditioning Association, Inc. (AMCA)

Each Ilg product shown carries the rating seal of the Air Moving and Conditioning Association, Inc.

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Chicago's new spectacular lake front Exposition Center

Performance records of millions of Sloan Flush Valves indicate that when McCormick Place is 50 years old its Sloan Flush Valves will still provide dependable service.

Moreover, Sloan Flush Valve maintenance costs are likely to be among the lowest in the building maintenance budget... (as little as 1½¢ per valve per year!)

Why gamble with substitutes when you can plan for the life of the building confidently with Sloan? Specify and insist on performance-proven, time-tested Sloan Flush Valves.

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SLOAN
FLUSH VALVES

For complete plant heating you need both...

WING

STEAM, HOT WATER OR HIGH TEMPERATURE HOT WATER*

REVOLVING and DOOR HEATERS

Wing Revolving Discharge Heaters give you:

Uniform heating . . . Warm air is distributed widely and evenly in a gentle flow—no hot blasts or cold areas — heat moves over and around obstacles.

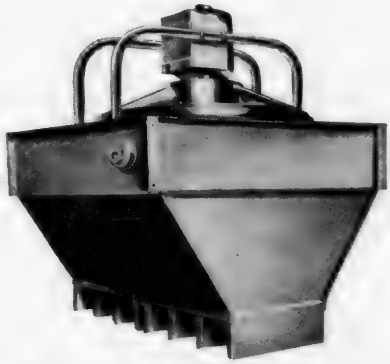
Big area coverage . . . Perfect heating coverage from mounting heights as low as 8′ and high as 65′—areas up to 144′ x 144′ can be covered by a single heater.

No heat stratification . . . All the heat paid for is used — truss area heat is recirculated to the working level — low temperature differentials are maintained.

Low installation cost . . . Fewer Wing Revolving Heaters are required to supply most plant heating needs — you save on wiring, piping and installation labor costs.

Simplified maintenance . . . Tubes are mechanically connected to headers. Individual tubes can be removed or replaced on the job — unnecessary to replace entire heater section.

WRITE FOR BULLETIN HR-6A



Wing Door Heaters give you:

Improved worker comfort and efficiency . . . Large shipping doors are blanketed with high velocity streams of warm air whenever they are opened in cold weather. Incoming cold air is effectively tempered. Nearby workers remain comfortable. Production stays normal. Draft caused illnesses are minimized.

Stabilized plant temperatures . . . The spreading of cold air through large plant areas is avoided even where negative pressures caused by exhaust systems prevail.

Low operating costs . . . Uses steam only when doors are open.

Wide range of sizes . . . Ten sizes are available to suit rolling, overhead or other types of industrial doors. The largest provides protection against outside temperatures as low as −20° F.

Wing Door Heaters can be supplied with Vari-Jet discharge. Automatically converts to perimeter or space heater when doors close.

WRITE FOR BULLETIN DH-2B

**Gas-fired models also are available*

WC-165

WING

L. J. WING MFG. CO.
DIVISION OF AERO-FLOW DYNAMICS, INC.
LINDEN, NEW JERSEY
FACTORIES: LINDEN, N. J. AND MONTREAL, CANADA
IN EUROPE: WANSON, HAREN-NORD, BRUSSELS, BELGIUM

Why 7 economy-minded engineers chose Transite Pipe to cut costs of moving water, power and gases!

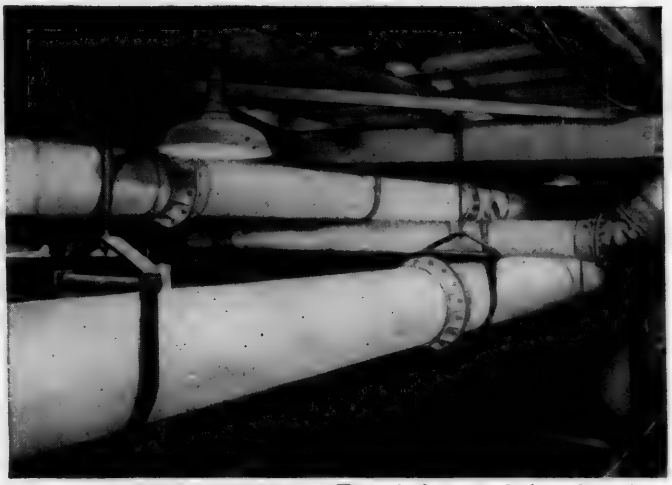
In every area of industrial piping, Transite® saves you money from time of purchase right on down through the years. Made of tough, durable asbestos cement, this "white pipe" has gained the acceptance of economy-minded plant engineers throughout the country. Available in economical lengths and diameters, Transite features easily-installed, permanently-tight couplings. Non-tuberculating, non-conductive, corrosion-resistant Transite keeps your systems operating smoothly and economically while requiring minimum maintenance. Learn how Transite's unique properties solved seven key piping problems.

HIGH WATER-CARRYING CAPACITY — Here Transite is being installed for pressure and fire lines by one of this country's largest metal companies. Transite resists tuberculation and electrolysis . . . maintains its high water-carrying capacity through the years.

RESISTS CORROSION — Transite, made of durable asbestos cement, resists the corrosive action of salt water and cinder fills. It is the choice of leading companies for salt water gathering and disposal lines.

NEW ECONOMIES — For storm water drainage and storm sewer systems, Transite provided a 25% savings in this new floor tile plant.

USED INDOORS OR OUT — Transite Industrial Vent Pipe — shown in the H. J. Heinz Research Center — saves on upkeep . . . resists attack by most gases, mists, fumes and dusts.



SMOOTH INTERIOR — Transite's smooth interior gives maximum resistance to sliming and bacterial growths. That's why the St. Regis Paper Company picked Transite for process water and stock lines.

WITHSTANDS AGGRESSIVE LIQUIDS — In the mining of copper and coal, a dual pipe system of Transite at Inspiration carries fresh water and removes tailings in suspension ranging up to 54% solid. Transite has an enviable record withstanding such aggressive liquids.

COOLER CABLES — Transite Ducts provide permanent service for underground power transmission and distribution lines. They do not deteriorate from heat, water or corrosive soil, and they dissipate heat faster. Cables run cooler, carry greater loads. Used by largest airports, public utilities and industries.

LEARN HOW YOU CAN HAVE THE ECONOMIC BENEFITS MAJOR COMPANIES ENJOY SINCE THEY INSTALLED TRANSITE PIPE. FILL IN AND MAIL THIS COUPON TO:

JM JOHNS-MANVILLE Box 362, AHV-10, New York 16, N. Y. In Canada: Port Credit, Ontario

Without obligation, please send information on Transite for plant piping. I am interested in:

- water supply lines ☐
- fire lines ☐
- industrial and sanitary waste lines ☐
- process lines ☐
- industrial vent pipe ☐
- subsurface drainage pipe ☐
- irrigation pipe for landscaped areas ☐
- electrical conduits ☐
- storm water drainage and storm sewer systems ☐

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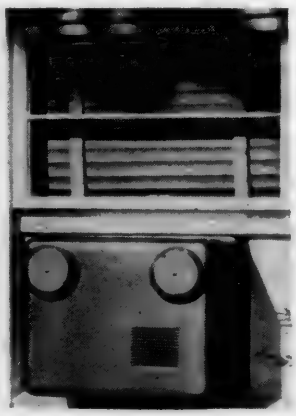
Solve Small Space Heating Problems with Suburban Novent-Dynavent GAS Heaters

Heat by the roomful...that's what you get when you specify Suburban Novent or Dynavent Gas heaters. No need to heat unused or unoccupied rooms. No flue or chimney needed. Ideal for added rooms, cabins, playrooms, closed-in breezeways, offices and garage workshops.

Suburban Novent and Dynavent Gas heaters give you all the advantages of modern gas heat . . . high efficiency, precise control, speed, cleanliness, economy and dependability of supply. Gas can be the answer to your unusual or everyday heating problems.



Heat better for less with Suburban Novent or Dynavent Gas heaters. For complete information, contact your local Gas Company, or write to Suburban Appliance Co., Dept. AV 1061, Morristown, New Jersey.

American Gas Association

Right: These units are installed at the Price Apartments, Nutley, New Jersey (shown above). Each apartment is individually heated to exactly the temperature desired by the occupants.

FOR HEATING... GAS IS GOOD BUSINESS!

SPORLAN THERMOSTATIC EXPANSION VALVES and REFRIGERANT DISTRIBUTORS

are the **PERFECT PAIR**
for **PEAK PERFORMANCE**

. . . they're
designed
to fit each other
for
smoother performance

Sporlan
Thermostatic Expansion Valves have proved to be the leader in the refrigeration and air conditioning field . . . and Sporlan alone offers you the tremendous advantages of the distributor with the Versatile Interchangeable Nozzle. It too has been the leader for many years.

No wonder then, that together they make the perfect pair for any installation.

Available in any combination of circuits and capacities, in flare, solder or flange connections.

For complete information see your Sporlan Wholesaler or write for Bulletins 10-10 and 20-10 today!

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CHASE MANHATTAN BANK
Contractor:
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320 PARK AVENUE
Contractor:
Raisler Corporation
Architect:
Emery Roth & Sons
Engineer:
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GETTY BUILDING
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The world's largest city is still growing upwards. new buildings in which Sarco-Sarcotherm

* **HEATING CONTROL SYSTEMS** for all types of heating, fully modulated, with complete automatic program panels. **STEAM TRAPS** of all 5 types, offered only by Sarco. **BALANCING FITTINGS** with unique solid segment stem for positive control. **RADIATOR VALVES** in a complete quality line, for steam or hot water. **CONDENSATE AND VACUUM PUMPS,** efficient, rugged, built to highest standards. **HEATING SPECIALTIES** including radiator traps, protective strainers, air eliminators and water blenders. The **SARCO-SARCOTHERM** name is assurance of excellence in heat conservation and control.

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Engineer:
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300 PARK AVENUE
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Architect:
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Engineer:
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All equipped by Sarco-Sarcotherm*

Here are just a few of the fabulous products have been installed.

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Architect:
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C.I.T. FINANCIAL BUILDING
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Contractor:
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Engineer:
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GUGGENHEIM MUSEUM
Contractor:
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2958

SARCOTHERM

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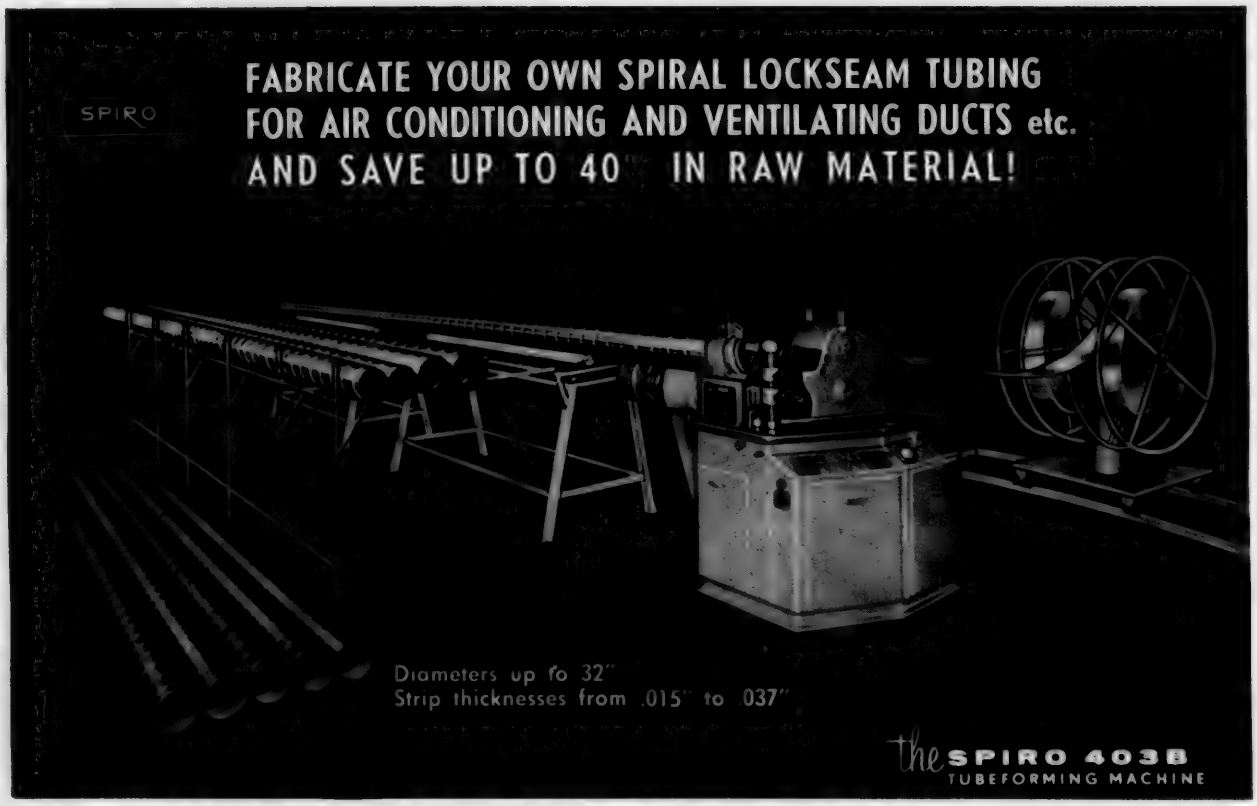
AN AFFILIATE OF SARCO COMPANY, INC.
635 MADISON AVENUE, NEW YORK 22, N. Y.
CONTROL SYSTEMS FOR STEAM, HOT WATER,
AND RADIANT HEATING

WHY MAKE DUCTWORK THE OLD FASHIONED WAY?


SPIRO
FABRICATE YOUR OWN SPIRAL LOCKSEAM TUBING
FOR AIR CONDITIONING AND VENTILATING DUCTS etc.
AND SAVE UP TO 40% IN RAW MATERIAL!
Diameters up to 32"
Strip thicknesses from .015" to .037"
the SPIRO 403B
TUBEFORMING MACHINE

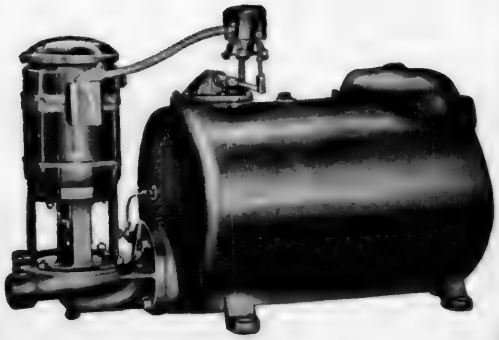
A major new development in the sheet metal industry. The patented SPIRO 403B will enable you to fabricate your own spiral lockseam tubing from any suitable quality strip metal (including galvanized steel) for high and low velocity air conditioning, general ventilation, fume and dust removal, warm air heating and many other applications.

- **The 4-ply reinforcing spiral lockseam gives the tube such strength that the thickness of the metal used may be reduced by as much as 50% over comparable conventional ducts.**
- **The high production speed, the quick changeover for various dimensions and the easy operation of the machine cut labor costs to a minimum and eliminate need for extensive stocking of finished ducts.**
- **Because of the great strength and rigidity of SPIRO ducts fewer supports are needed thereby reducing installation cost.**

The SPIRO 403B is supplied complete with decoiler, cutter, run-off table with discharge mechanism and receiving ramp. This fully automatic machine produces tubes to any length required (up to 20' with standard equipment).

For more information write, wire or phone to **SPIRO U. S. A., INC.**

20 N. WACKER DRIVE • CHICAGO 6, ILL. • CENTRAL 6-4465



SKIDMORE
TYPE "VC" PUMP

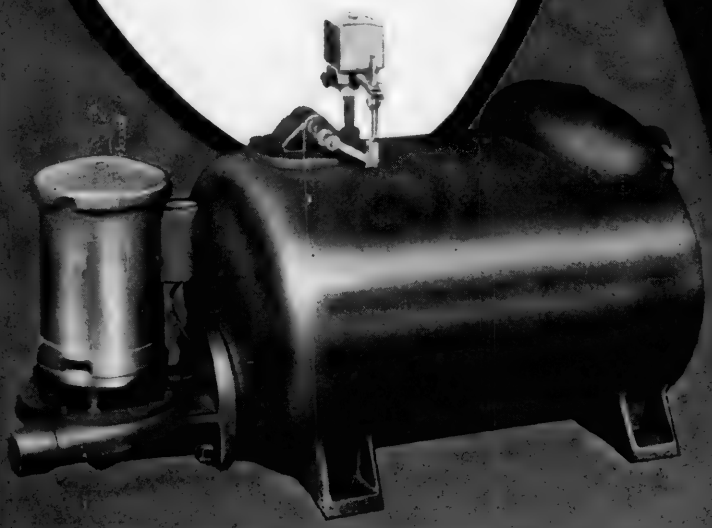
TYPE "VC" PUMP

Always a favorite for smooth dependable operation . . .

NOW!

THE NEW SKIDMORE "VCS" PUMP

Featuring mechanical shaft-seal and close-coupled design . . .



SKIDMORE TYPE "VCS" PUMP

You get much more when you specify a Skidmore heating pump . . . many extra features that go into custom-made installations are standard with a Skidmore pump at no extra cost. You also get quality construction — compact design — ease of maintenance — and quiet operation. Select from a complete line of both horizontal or vertical pumps. Every Skidmore pump is engineered to meet your exacting requirements. See your nearest Skidmore Representative or write for bulletins.

Write today for Bulletin No. 10-C

SKIDMORE CORPORATION • ST. JOSEPH, MICHIGAN

Edward Ross, President, Economy Plumbing Co., Mechanical Contractor for the Pure Oil Building, Palatine, Illinois, says:

"Pure Oil was an elaborate Honeywell helped

Mr. Edward Ross of Economy Plumbing. Mr. Ross found the Honeywell Selectographic Data-Center of great help in analyzing the performance of Pure Oil's temperature control systems.

job, but
us over the rough spots"

ARCHITECTS: *Perkins & Will, Chicago*
CONSULTING ENGINEER: *E. R. Gritschke Assoc., Chicago*
MECHANICAL CONTRACTOR: *Economy Plumbing Co., Niles, Ill.*

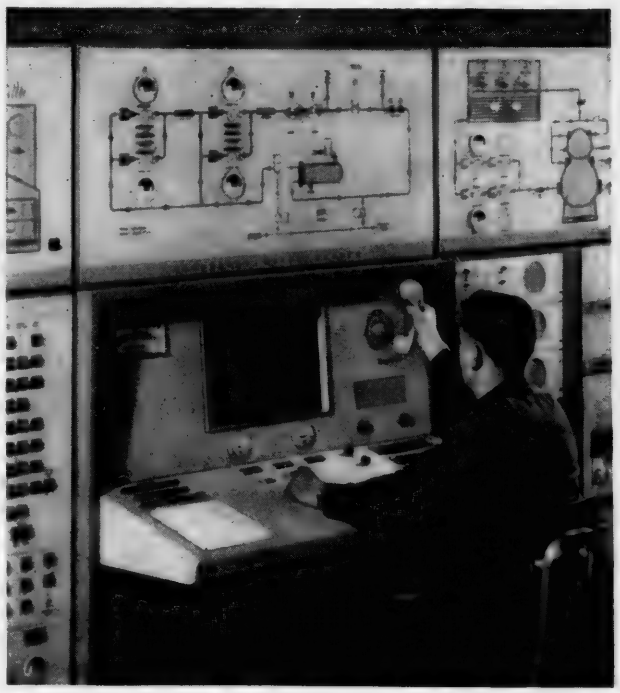
At Pure Oil's new home, individual temperature control in over 400 rooms is maintained and constantly supervised by a Honeywell Selectographic DataCenter*.

"This new Pure Oil Building has one of the most intricate temperature control systems we've ever seen," says Mr. Ross. "In fact, there are more individual controls than in 99% of the systems built today." Mr. Ross adds: "We counted on Honeywell for accurate scheduling and over-all supervision of the installation—and they came through! Honeywell always had enough engineers and technicians on the job to keep everything rolling smoothly. It's very reassuring to know Honeywell's on your team."

The Honeywell Selectographic DataCenter controls temperatures for the entire Pure Oil Building. It also includes control over a building-wide security system and fire alarm system. Because the fire alarm system is hooked up to the local fire department, one of Honeywell's many jobs was to indoctrinate the Palatine Fire Department on the Selectographic and the new fire alarm system.

With 76 years experience in temperature control you can depend on Honeywell quality and service. Fine controls, accurate specifications, prompt delivery and expertly supervised installations are assured with Honeywell on your team. And only Honeywell designs and manufactures all three types of control systems—pneumatic, electric and electronic. For further information, call your nearby Honeywell Office. Or write Honeywell, Dept. HV-10-126, Minneapolis 8, Minn.

**Trademark*



Fred Heiden, Utility Operator for the Pure Oil Building, seated at the Selectographic DataCenter.

Honeywell

First in Control

SINCE 1885

HONEYWELL INTERNATIONAL
Sales and service offices in all principal cities of the world. Manufacturing in the United States, United Kingdom, Canada, Netherlands, Germany, France, Japan.

For strength and ductility you can't beat

BETHCON GALVANIZED STEEL SHEETS

Bethcon galvanized sheets have a remarkable combination of strength and ductility that assures smooth shopwork and satisfied customers.

Bethcon sheets owe their superior qualities to Bethlehem's continuous annealing process which gives the base steel its strong-yet-workable characteristics.

Bethlehem's continuous galvanizing process bonds the zinc coating so tightly to the steel that you can put a Bethcon sheet through the toughest forming processes without cracking or flaking the coating.

Bethcon is available in a wide variety of gages, in coils or cut lengths, with either plain open-hearth or copper-bearing (Beth-Cu-Loy) steel for the base metal. If you want further information on Bethcon, your inquiry will get prompt attention from the nearest Bethlehem office.

for Strength
... Economy
... Versatility

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.
Export Sales: Bethlehem Steel Export Corporation

BETHLEHEM STEEL

BETHLEHEM STEEL

no motor burn-out system contamination with this "open" compressor

B&G Compressors are built in atmosphere-controlled shops under rigidly checked manufacturing methods. Available in capacities from 7½ to 150 tons.

B&G builds "open" compressors because in actual operation they offer many exclusive and outstanding advantages. Where an open compressor is used, elaborate precautions to evacuate and dehydrate a refrigeration system are not necessary. It can be serviced by the average contractor —no special tools or equipment needed.

Motor burn-out in a closed system leads to system contamination—with an exceedingly involved procedure necessary to clean up the system. This means considerable down-time and possible large loss of revenue or spoilage.

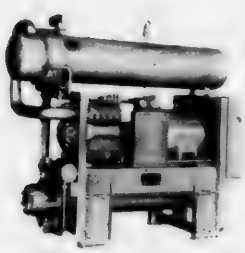
Quieter operation with less vibration are distinguishing features of the B&G Compressor. It is engineered to establish higher standards of performance...ruggedly built for longer life. It has fewer parts, hence presents fewer maintenance problems. All units have *one* bore—a few interchangeable parts will service them all.

Send for literature

BELL & GOSSETT
COMPANY
Dept. RGV-4, Morton Grove, Ill.

Canadian Licensee: S. A. Armstrong, Ltd., 1400 O'Connor Drive, Toronto 16, Ontario

A FULL LINE OF REFRIGERATION AND AIR CONDITIONING "PACKAGES" AND COMPONENTS

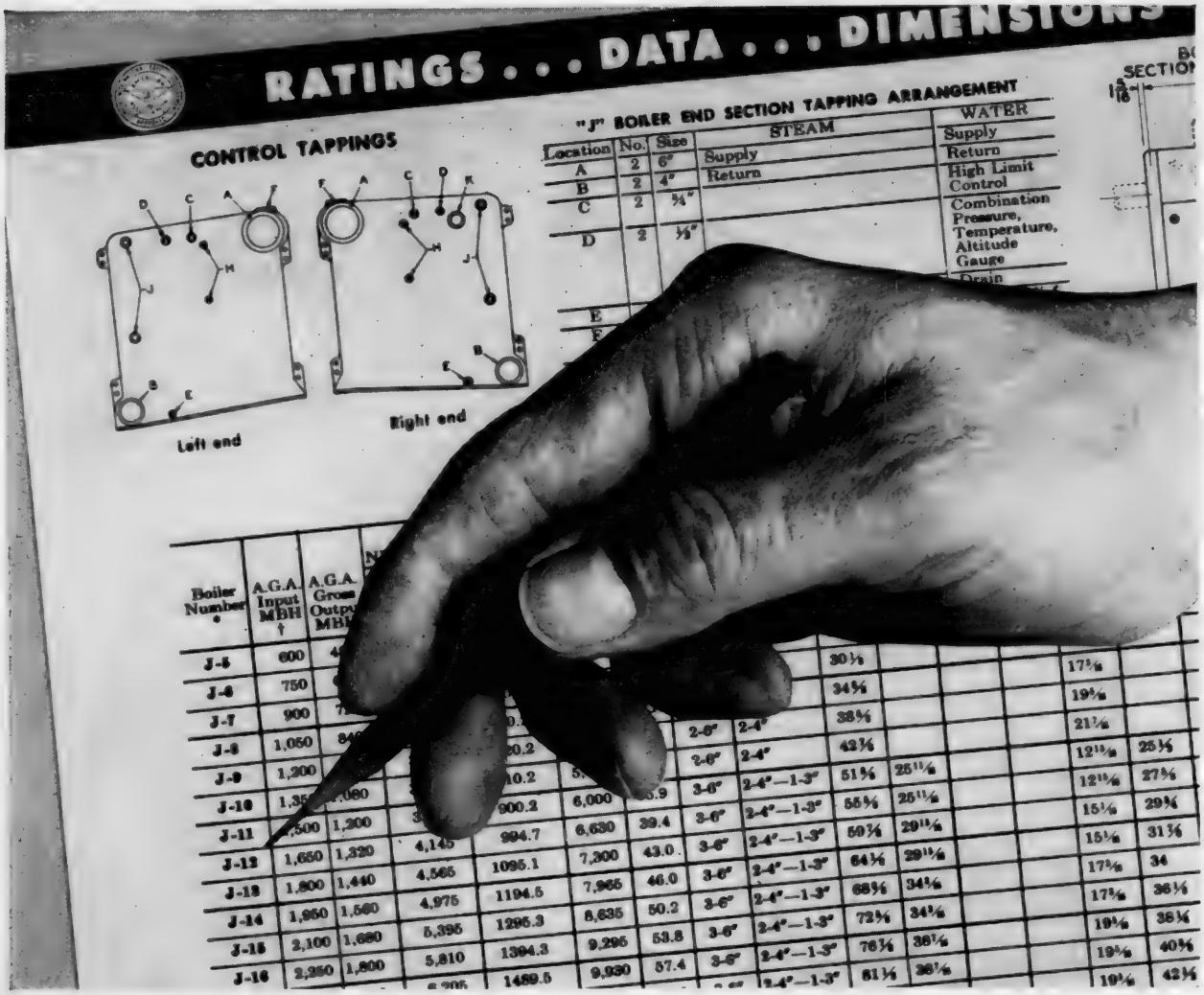


B&G Package Liquid Cooler

B&G Evaporators

B&G Centrifugal Pumps

B&G Condensers


RATINGS . . . DATA . . . DIMENSIONS
CONTROL TAPPINGS
Left end
Right end
"J" BOILER END SECTION TAPPING ARRANGEMENT
Location | No. | Size | STEAM | WATER
A | 2 | 6" | Supply | Supply
B | 2 | 4" | Return | Return
C | 2 | ¾" | | High Limit Control
D | 2 | ½" | | Combination Pressure, Temperature, Altitude Gauge
Boiler Number | A.G.A. Input MBH | A.G.A. Gross Output MBH

33 GAS BOILER SIZES IN 500 sq. ft. INCREMENTS PREVENT OVERSIZING WASTE

Oversizing a boiler because of inability to closely match boiler capacity to heating load increases operating cost and required boiler room space.

In Weil-McLain Type "J" Gas Boilers, the flexibility of cast iron sectional construction has permitted the design of a complete line of boilers *with sizes increasing in steps of only 500 gross sq. ft. each!*

Close sizing is only one of the ways in which a "J" Boiler saves money. For example, a high chimney, or forced or induced draft are not necessary for proper operation...all "J" boilers can operate with only a vent. And rating for rating, a "J" boiler takes less boiler room space than a typical scotch marine boiler.

Other *"extra values"*

A.G.A. approved efficiency...available with A.G.A. approved dual fuel manifold...Electronic controls and pre-wired control panels are engineered as part of unit...no refractories, motors, fans, tubes or water treatment.

TYPE "J" GAS BOILER

Net I=B=R Capacities: 360,100—3,354,000 BTU/hr.

Send for Bulletin C-297

WEIL-McLAIN CAST IRON BOILERS

WEIL-McLAIN COMPANY • Dept. BB-101 • MICHIGAN CITY, INDIANA

Presenting—

—a new concept in welding fittings

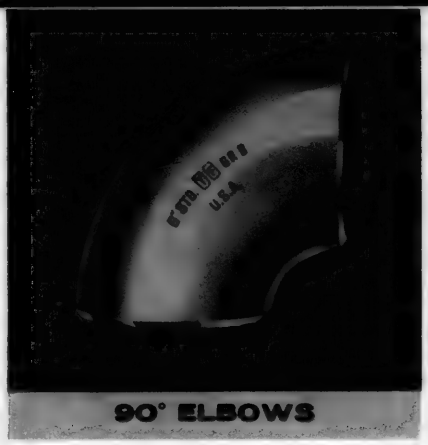
It's the NEW

TAYLOR FORGE COMPACT LINE

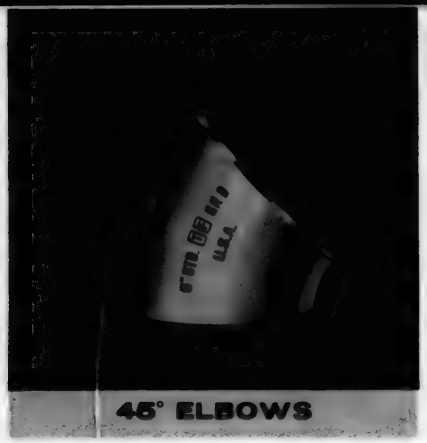
for greater economy in heating/cooling system piping

T F
TRADITIONALLY DEPENDABLE

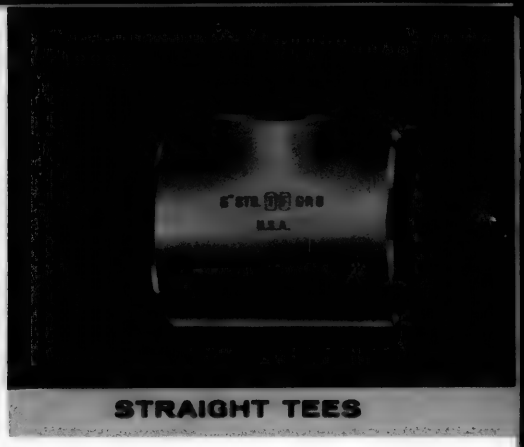
FACTS FOLLOW



90° ELBOWS

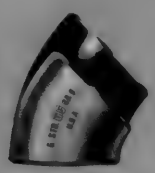


45° ELBOWS



STRAIGHT TEES

For the first time...fully dependable.. reduce costs..



Functional Design At a Glance

These photographs show the dimensional differences between Compact Fittings and corresponding conventional fittings. The Compact 90° elbow is contrasted with a conventional long radius elbow which is by far the most commonly used type. Dimensions of the Compact 90° elbow are the same as those of the regular Taylor Forge short radius (1-R) WeldELL. The lower cost of 90° Compact elbows is made possible by large volume runs of a limited number of sizes, each in a single thickness, and particularly by new and improved mass production methods. The 45° elbow has heretofore been obtainable only in the long radius pattern.

What we have here is one of those "why-didn't-someone-do-it-before" ideas. By providing new designs and new dimensions as shown in the accompanying illustrations, the new Taylor Forge Compact Line of welding fittings truly represents the first major break with tradition in the 30-odd years since welding fittings were first introduced in America.

But you can be sure that although the designs and dimensioning have been changed, there has been no change whatever in the quality standards and manufacturing integrity that have been traditionally associated with Taylor Forge products for more than a half century.

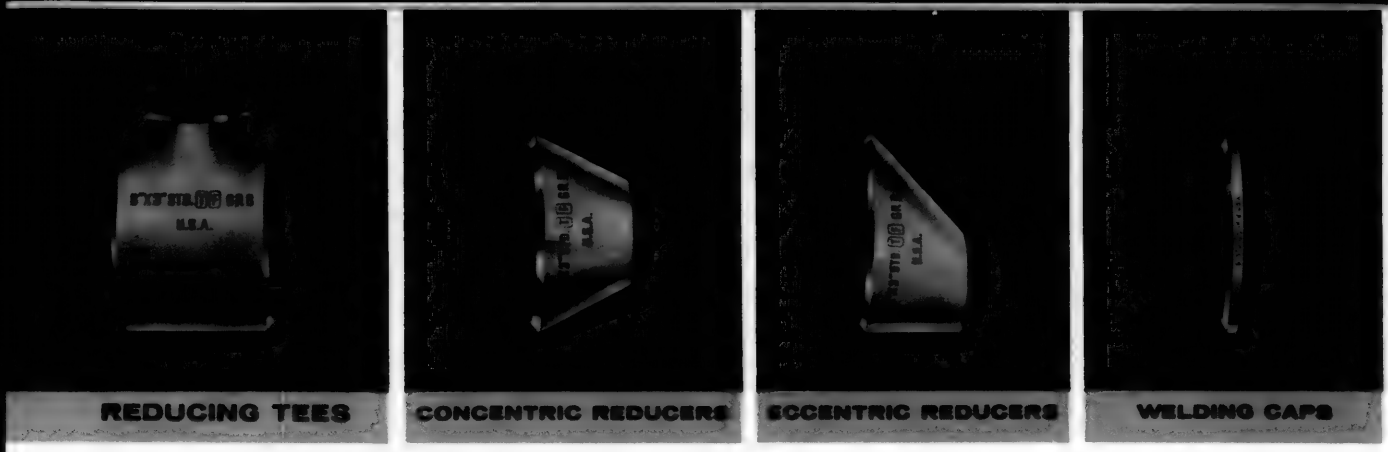
The new designs and reduced dimensions permit simplified and improved mass production methods and lower manufacturing costs. More compact design and reduced weight also bring important savings in shipping, trucking, storing, on-the-job handling and installation.

Common though functional design has been in other fields, it remained for Taylor Forge to apply to welding fittings the principle of designing and dimensioning *functionally* . . . for *savings*.

Rugged Strength

Taylor Forge Compact Fittings are *seamless*. They are of nominal Standard (Schedule 40) wall thickness. Ends are accurately beveled and sized to match corresponding Schedule 40 pipe. Only Grade B carbon steel is used in making them.

Because they are designed for heating/cooling system piping and similar low or moderate pressure service, they are arbitrarily designated as Class 125 and therefore carry the customary WOG rating of 175 psig (125 psig for saturated steam). The cyclic and bursting tests on the last page of this advertisement will show you how conservative this rating is.



REDUCING TEES | CONCENTRIC REDUCERS | ECCENTRIC REDUCERS | WELDING CAPS

..American-made welding fittings that ..through functional design

Easy to Weld

Before putting Compact Fittings on the market, tests were made to determine ease of welding. Experienced welders, working under job conditions, found them easy to handle—under many conditions actually more convenient than corresponding conventional fittings.

Adequate Range of Sizes and Types

The Taylor Forge Compact Line, like the fittings themselves, is "streamlined" for greater manufacturing economy. It embraces, nevertheless, practically all of the sizes and types of fittings usually required in heating/cooling system piping.

The line includes 90° and 45° Elbows, Straight and Reducing Tees, Concentric and Eccentric Reducers and Caps, in sizes 2", 2½", 3", 4", 5" and 6". Reducing Tees and Reducers are offered with reductions in the intermediate IPS sizes down to one-half of the nominal run or large end size.

It will be seen that, except for piping around boilers in very large installations, this range of sizes and types is completely adequate. The occasional larger or smaller size that may be needed can be furnished by the same Taylor Forge Distributor from his stock of Standard Taylor Forge Fittings.

Marking

All fittings have complete identification markings and are painted bright orange, as illustrated, with non-toxic, corrosion-resistant paint.

Compact fittings are now carried in stocks for immediate delivery by Taylor Forge Distributors in all important trading centers. Use the coupon to ask for bulletin, and name of your nearest distributor.

WHAT THE COMPACT LINE MEANS:

to the Consulting Engineer: Fittings that can be specified or approved with complete assurance of full strength and service life equal to that of the pipe itself. Uniform excellence and dependability backed by one of America's oldest, largest and most respected manufacturers of products for piping and pressure vessel construction.

to the Mechanical Contractor: No longer is it necessary to "shop around" or perhaps even take chances with foreign made fittings of questionable quality—and with no recourse to the manufacturer when things go wrong. Now you can be sure of *both* high quality *and* utmost economy by choosing Taylor Forge Compact Line Fittings for that next heating/cooling contract.

TAYLOR FORGE COMPACT LINE

Get a seat on the aisle for the curtain raising

[... Mail coupon on reverse side]

Long Service Life Assured

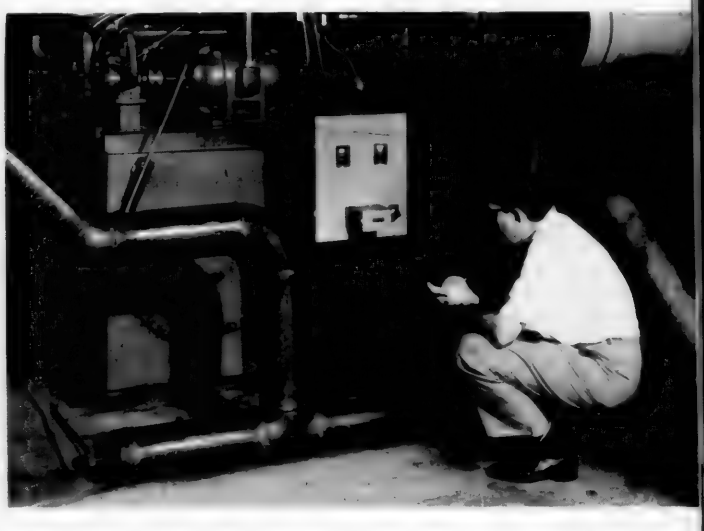
Tests prove strength and quality of TAYLOR FORGE Compact Fittings

The photographs here show a cyclic pressure test of Compact Fittings which gives conclusive proof that they are conservatively rated and that the expected service life of the fittings is equal to that of the pipe itself.

The test unit was fabricated from 4″ and 6″ Standard Thickness (Schedule 40) Grade B pipe and includes a 6″ x 6″ x 6″ Tee, a 6″ 90° Elbow, a 6″ 45° Elbow, and a 6″ x 4″ Concentric Reducer—all Compact Line Fittings. In testing, a mean pressure of 875 psig (five times WOG rating) was established as basic pressure. Cyclic pressure variation was from 50% under to 50% over this pressure—in other words, from 437 psig to 1312 psig. The assembly was then subjected to 36,500 of these pressure cycles—the equivalent of one cycle per day for *100 years!*

How did it stand up under this punishment? Upon completion of the cyclic testing, the unit was hydrostatically burst, the break occurring, as it theoretically should, in the crotch of the tee and extending into the adjacent run and branch pipes. Moreover, the unit had to be brought to a pressure of 5200 psi before bursting, yet the theoretical bursting pressure of 6″ pipe is only 5080 psi. After 36,500 pressure cycles this result is rather startling.

This and similar tests conclusively prove the rugged strength and complete dependability of Taylor Forge Compact Line Fittings.



Cyclic pressure test of unit containing Taylor Forge Compact Line Fittings.

Unit hydrostatically burst after 36,500 cycles; bursting pressure 5200 psi—a remarkable demonstration of the high quality of these economical new fittings.

Taylor Forge and Pipe Works

General Offices and Works: P. O. Box 485, Chicago 90, Illinois
Plants: Carnegie, Pa.; Somerville, N.J.; Gary, Ind.; Houston, Texas; Fontana, Calif.; Hamilton, Ont., Canada
District Sales Offices: New York, Philadelphia, Pittsburgh, Atlanta, Chicago, Houston, Tulsa, Los Angeles, San Francisco, Seattle, Hamilton, Calgary, Montreal

SEND BULLETIN COVERING NEW TAYLOR FORGE COMPACT LINE FITTINGS

Name _____

Firm _____

Position _____

Address _____

_____

MAIL TO TAYLOR FORGE & PIPE WORKS, P.O. BOX 485, CHICAGO 90, ILL.

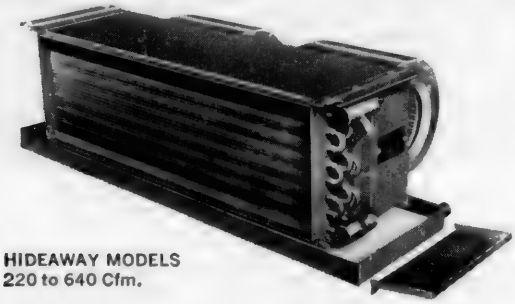
COUPON BRINGS COMPLETE FACTS

Mail the coupon for bulletin containing complete facts and tables showing sizes, dimensions, weights of Compact Line Fittings. We will give you the name of your nearest Taylor Forge Distributor stocking the Compact Line.

Printed in U.S.A.

McQuay

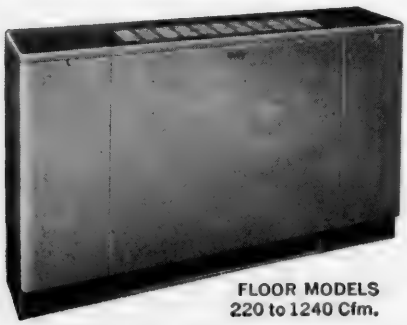
individual room **SEASONMAKERS**



HIDEAWAY MODELS
220 to 640 Cfm.

Your design plans may specify a free standing floor conditioner, or possibly floor units semi or fully recessed, and in some instances, closet or false ceiling installations or horizontal ceiling units mounted in the conditioned space—but, regardless of what your plans require, there is a McQuay Seasonmaker designed to meet your specifications. Four individual models, floor, basic, ceiling and hideaway styles in 24 sizes, with a complete accessory line for each style, offer you the versatility and flexibility required in modern design.

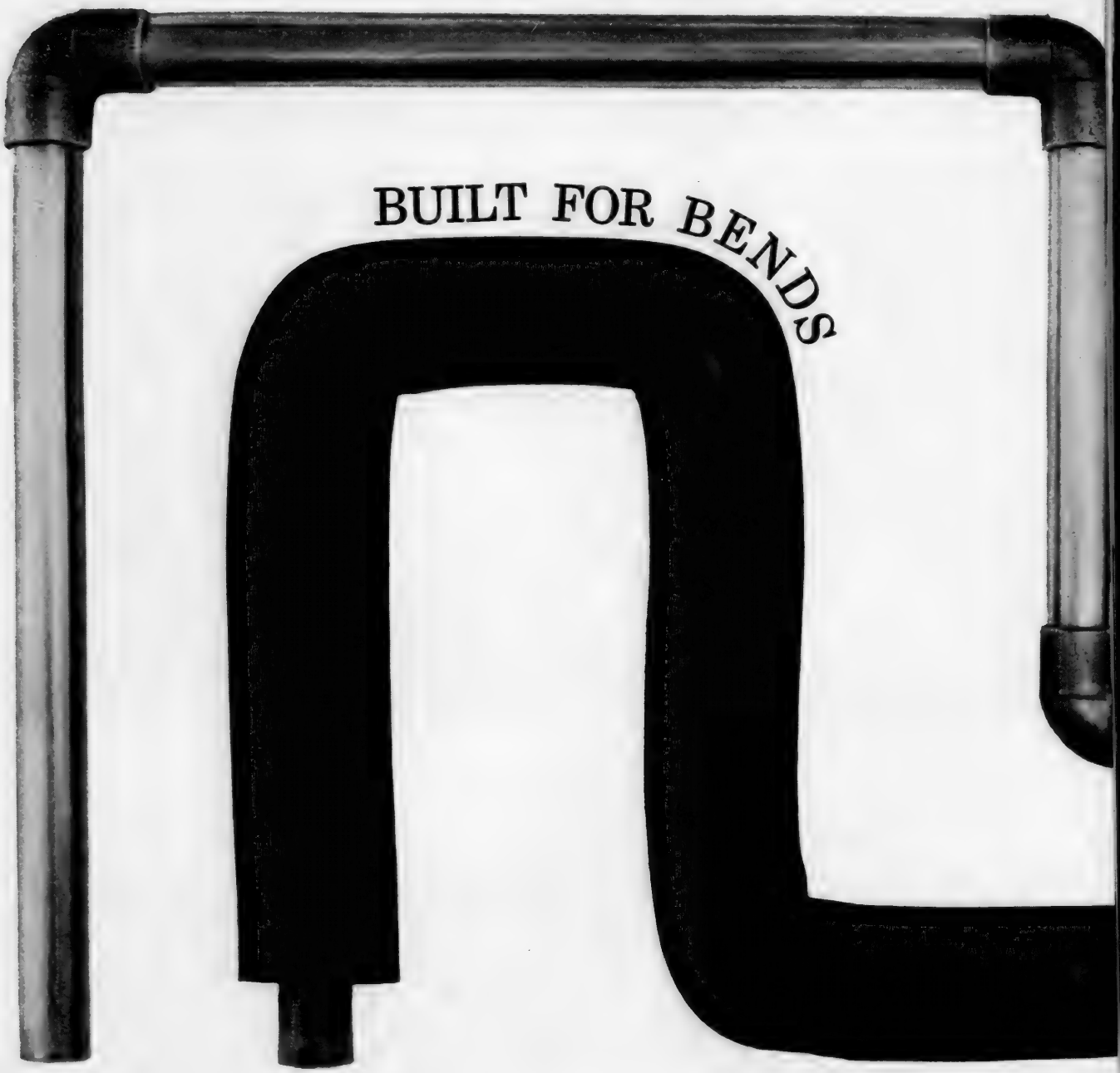
Before you specify or install, insist on comparing the McQuay Seasonmaker with all others for quality construction, quietness, appearance and performance. Your McQuay representative will give you complete Seasonmaker information, or write to McQuay, Inc., 1619 Broadway N.E., Minneapolis 13, Minnesota.



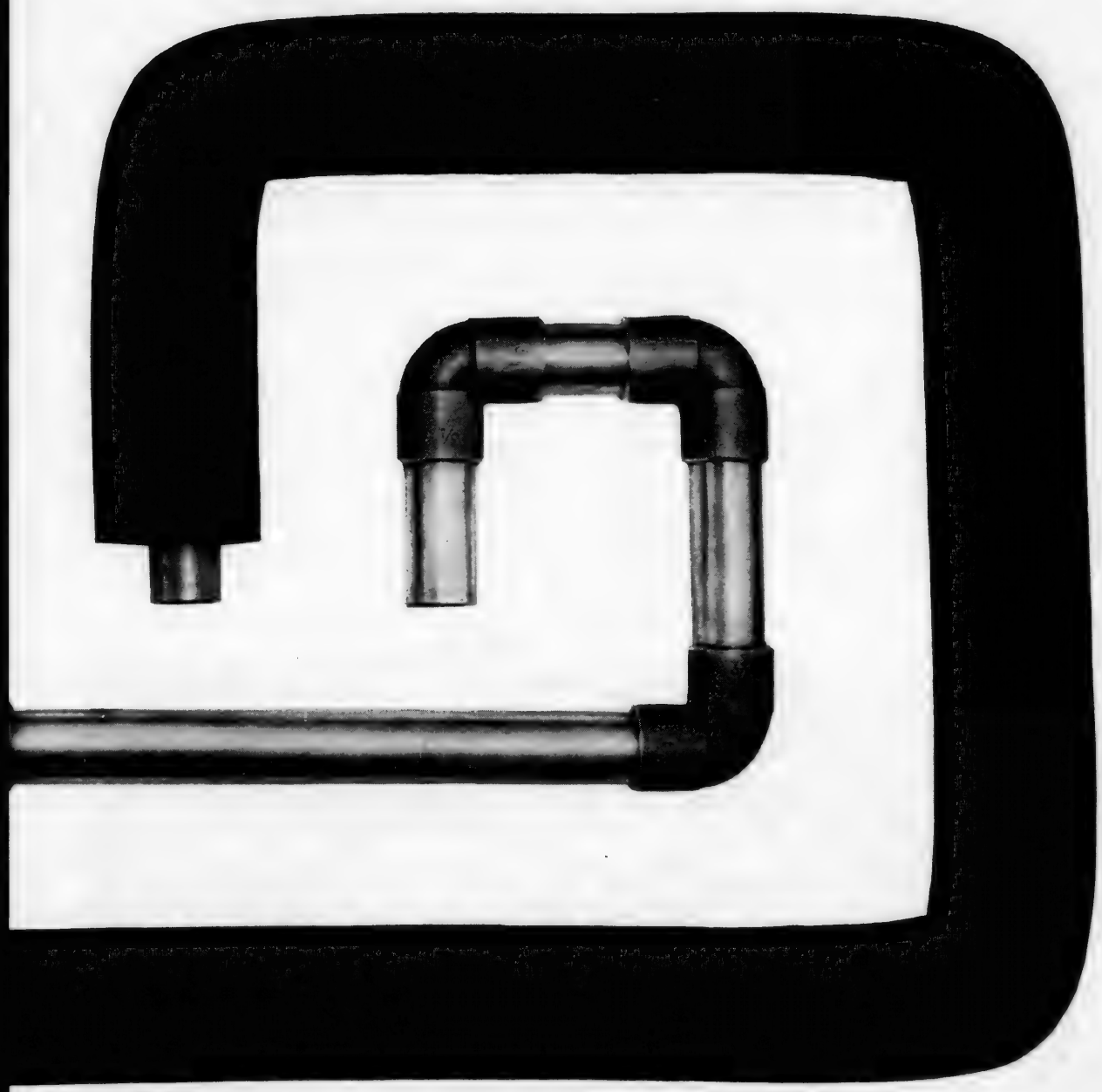
FLOOR MODELS
220 to 1240 Cfm.

McQuay INC.

AIR CONDITIONING • HEATING • REFRIGERATION



J-M Aerotube... a flexible, anti-sweat insulation designed for quick installation on bent tubing!

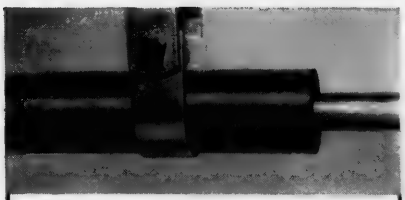


Now you can end the problem of pipe condensation on any indoor line quickly, easily and economically. With Johns-Manville Aerotube® even the most complex bend is a snap to insulate.

Aerotube is a flexible, foamed-plastic pipe insulation for use at temperatures from 32F to 220F. Its closed-cell structure prevents the passage of moisture under normal design conditions on indoor lines.

Because Aerotube is a flexible product (you can actually tie it in knots), it permits unique installation economies. The six-foot lengths go on quickly and easily. On new installations, simply slide Aerotube over tubing or pipes. For existing installations just slit Aerotube, snap it on and cement joints. That's all. Field reports show that installation costs can actually be cut in half.

If you have a condensation problem on heating, plumbing or air conditioning service lines, Aerotube can solve it. For full details, write to J. B. Jobe, Vice President, Johns-Manville, Box 14, New York 16, N.Y. In Canada: Port Credit, Ontario. Cable: Johnmanvil.



ALSO AVAILABLE...
A RIGID AEROTUBE

For compression-free insulation at pipe supports or for underground use, J-M's rigid Aerotube is recommended.

JOHNS-MANVILLE

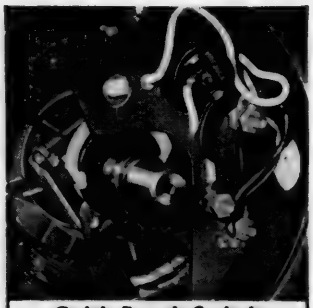
AN INSULATION FOR EVERY COMMERCIAL AND INDUSTRIAL USE

JOHNS-MANVILLE JM PRODUCTS

NO STARTING PROBLEMS

with

WAGNER CAPACITOR-START MOTORS



Quick Break Switch

The starting winding is disconnected from the line by this Wagner designed switch . . . test proved to make more than a million breaks. (That adds up to two starts per hour for 50 years!)

Quick Connect Terminals

Brass tabs on terminal studs permit quick, easy connection of leads . . . cut wiring time to speed assembly line production. Simply press the lead receptacle on to the stud—a positive connection is assured.

Pack more power into less space . . . give long troublefree service . . . are easy to hook up

Here are general purpose single-phase motors that have high starting torque and high pull-in torque. When used in the proper application and supplied with voltage close to their rating, they'll give positive starts every time. Troublefree operation is assured . . . thanks to the positive action of the Wagner governor mechanism and long life quick-break switch.

Wagner Type RK Motors pack more power into less space. Small enough to fit in tight spots, their ruggedness is built-in . . . permits direct mounting. They are available in a range from ¼ through 5 horsepower, with sleeve or ball bearings, and with rigid bases or resilient mountings. And, sleeve bearing fhp models can be operated in any position.

Get these motors from leading distributors in your city, or from Wagner Sales Offices in 32 cities across the country. Your Wagner Sales Engineer will be glad to help you select the right motor for your application. Wagner Bulletin MU-217 gives full details on Capacitor-Start Motors.

Wagner Electric Corporation

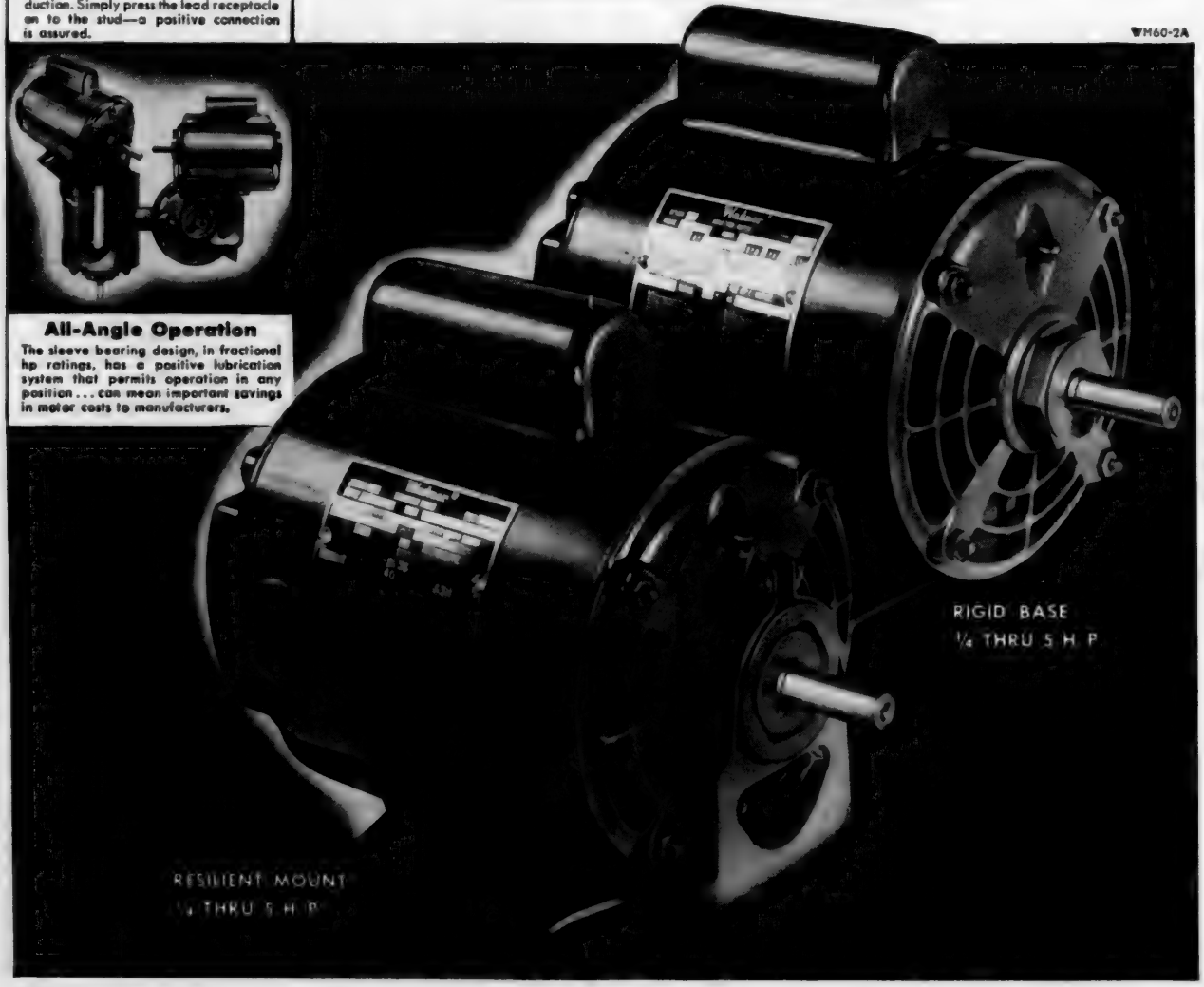
6463 PLYMOUTH AVENUE. ST. LOUIS 33, MO., U.S.A.

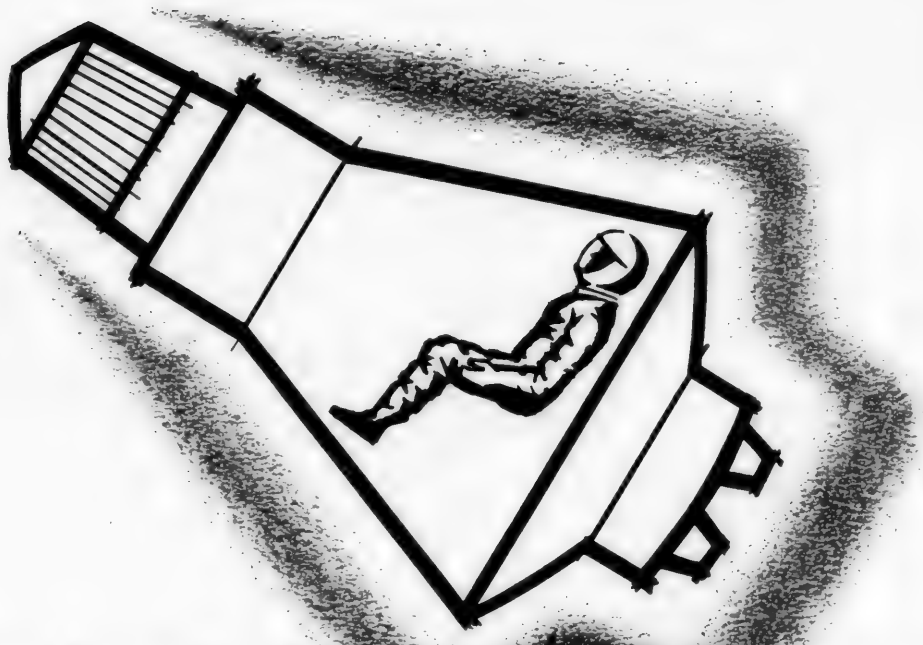
Manufacturers of LOCKHEED® Products

WM60-2A

All-Angle Operation

The sleeve bearing design, in fractional hp ratings, has a positive lubrication system that permits operation in any position . . . can mean important savings in motor costs to manufacturers.





fresh air for man in space through activated charcoal

To blast a Mercury space capsule into orbit around the earth takes power. To keep it there takes air—fresh air to sustain life of the astronaut inside. Ten feet long and little more than six feet wide at the widest point, it contains little room for a man and all the observation and control equipment which must be included. And part of this equipment is a source of air and a means of purifying and reusing it.

The Mercury capsule is hermetically sealed against the vacuum of outer space. It must bring home the air it starts with. Even with no other contamination, just breathing would soon make the air stale. Add natural body odors, odors inherent in equipment and materials built into the capsule, and the lavatory arrangements and you soon have the makings of an unbearable atmosphere.

One of the oldest and most effective methods of solving the problem of air purification is odor adsorption by activated charcoal.

The problem of pure air for our astronauts was solved 45 years ago. Since World War I Barnebey-Cheney activated charcoal filters have become standard equipment in gas masks and on all of our nuclear powered submarines. Odors and contaminants are trapped and held in activated charcoal until released by a reactivation process.

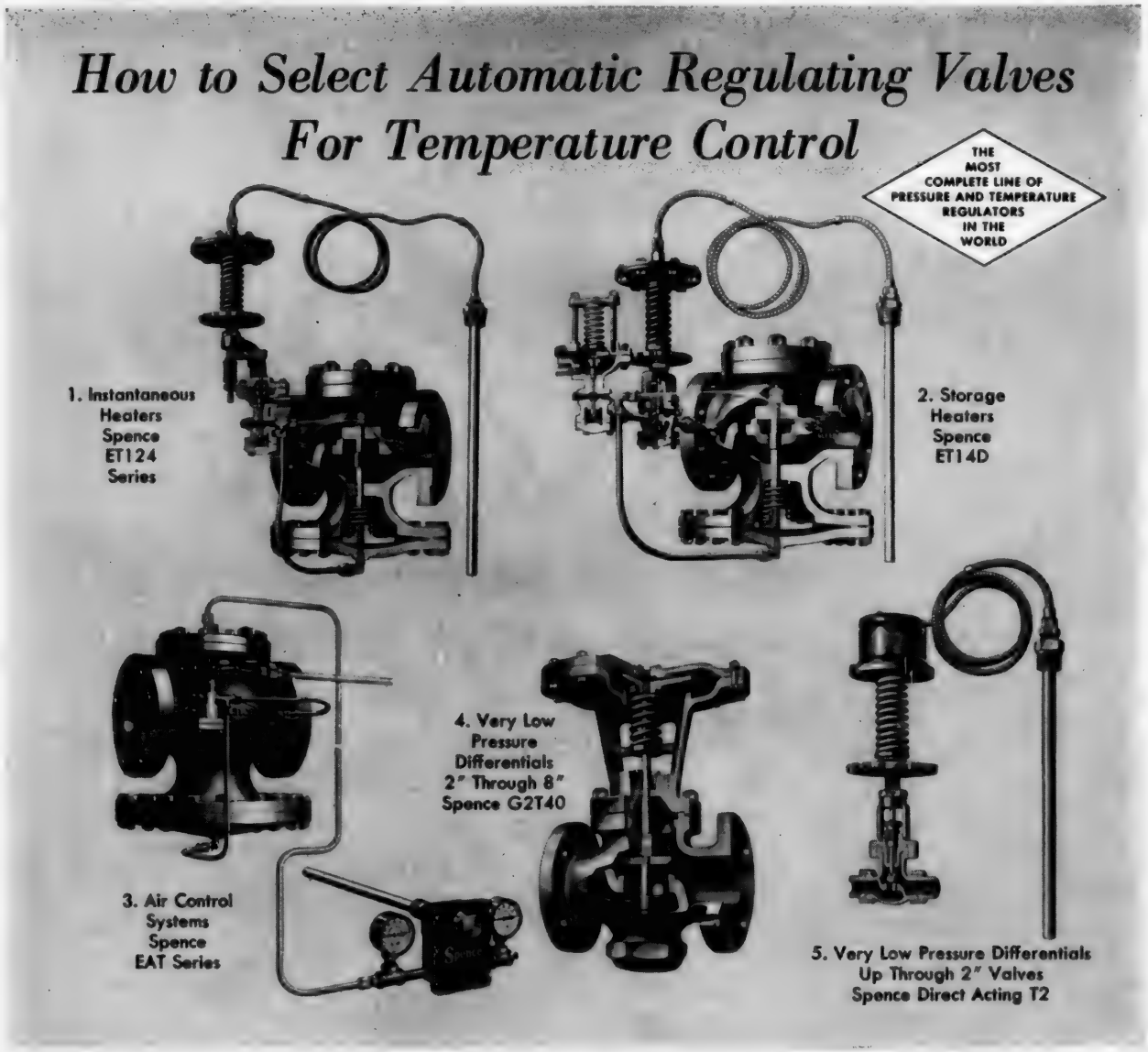
The same principle is being applied to offices, schools, hospitals and a variety of home appliances where fresh, healthful, odor-free air is essential. Barnebey-Cheney builds a complete line of standard and custom air purifiers for any size application from disposable filters for window air conditioners to central system purifiers for Chicago's O'Hare Airport and the huge Dallas Auditorium.

True air conditioning must include air purification. Activated charcoal is the proven practical means of accomplishing it.

To learn more, write for Bulletin T-377 Barnebey-Cheney, Columbus 19, Ohio.

Barnebey Cheney

How to Select Automatic Regulating Valves For Temperature Control


THE MOST COMPLETE LINE OF PRESSURE AND TEMPERATURE REGULATORS IN THE WORLD
1. Instantaneous Heaters Spence ET124 Series
2. Storage Heaters Spence ET14D
3. Air Control Systems Spence EAT Series
4. Very Low Pressure Differentials 2" Through 8" Spence G2T40
5. Very Low Pressure Differentials Up Through 2" Valves Spence Direct Acting T2

During the past year, our field representatives have reported many cases of improperly, and uneconomically, applied temperature regulators. To help you avoid some of these costly mistakes, here are a few tips on selecting the most effective and economical temperature regulating valves for your applications.

1. Instantaneous heaters require a special action for close temperature control and freedom from hunting. In the Spence ET124 series, steam pressure is modulated according to temperature (demand) and is automatically regulated at any pressure established by the demand.
2. Storage heaters, on the other hand, are more economically controlled by the Spence ET14D, which includes a simple temperature-actuated pilot that opens and closes the main valve to maintain a constant temperature.
3. Air control systems can now have a ±5°F control accuracy under wide and instantaneous load swings with the Spence EAT regulator. Engineers report savings of up to 50% in installed costs with this recently developed Spence cascade system when it has been used in place of conventional instrumentation.
4. For the combination of very low pressure differentials and air or water control, Spence recommends Type G2T40. This single seated valve provides fast, positive response in 2" through 8" valves. Double seat Type G22 is also available in 10" through 12".
5. When very low pressure differential is encountered with valves of 2" or less, the Spence direct operated T2 is recommended. The sensitive vapor tension thermostat responds quickly to small changes in bulb temperature for continuous, accurate control.

In this brief description of industrial process and heating temperature control, we have given a few important tips in proper regulator selection. If you would like more detailed information on these control applications, write for the new Spence Temperature Control Bulletin IV 1014. 9E-150

SPENCE ENGINEERING COMPANY, INC.
Walden 1, N. Y.
Paulsen Spence, P. E., President

IN TUBING—Nothing Beats Copper!
IN COPPER—Nothing Beats
READING!

For

COPPER WATER TUBE

Specify

READING "LEKTRONEAL"®

Ideal in

- General Plumbing
- Heating Systems
- Drainage Waste and Vent Lines
- Sprinkler and Irrigation Systems
- Rural Installations

Features • Soft Temper Tubes Can Be Curved Around Corners and Obstructions and thru Small Openings, yet Are Rigid Enough to Keep from Sagging without Support.
• Solder Fittings Can Be Applied More Quickly, Easily, Conveniently.
• Cuts Installation Costs Substantially as Compared with Other Materials.
• Enduring • Bright Clean Finish
• High Heat Conductivity

Send for Complete Catalog

For
COPPER REFRIGERATION TUBE
Specify
READING "LEKTROSEAL"®

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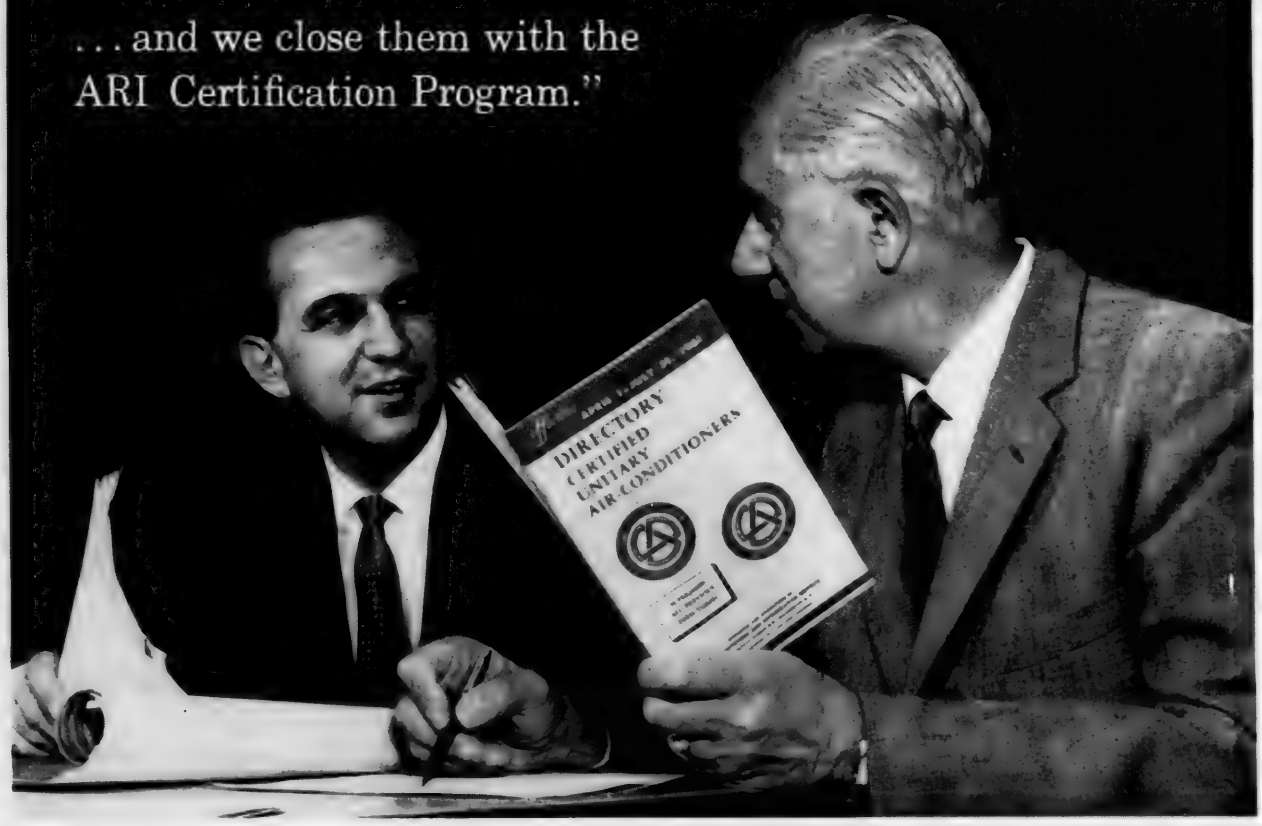

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"Our firm has a reputation for integrity, but we have profited from the *extra* confidence inspired by the impartial authority of the industry-approved ARI Certification Program. It is often the decisive factor in closing a sale."

Free copies of the ARI Directory and "How to Buy Central Air Conditioning" are yours for the asking. Write to:

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**Mr. George Rosen is President and General Manager of R & M Air-Conditioning Co., Inc. of Washington, D.C.*

Low Water Cut-offs on Hot Water Boilers?!

...the industry has given the answer

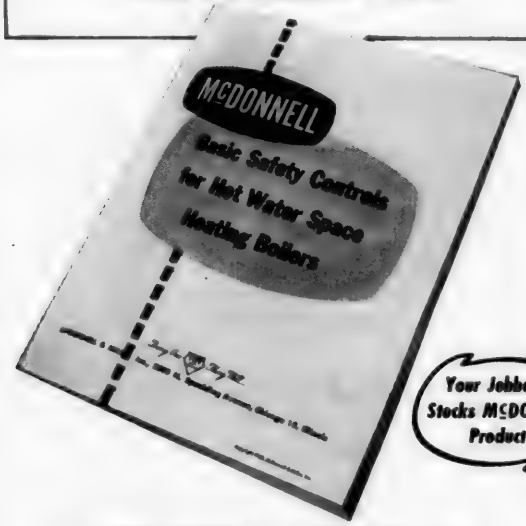
Yes, the answer has come from the field . . . from the engineers, contractors and manufacturers. They have seen the logic of installing a water level control on hot water space heating boilers . . . a low water cut-off, or—for even greater precaution—a feeder cut-off combination.

We knew it was a good idea. Expected it to grow and grow. But frankly we have been surprised at how rapidly the heating industry has taken hold of water level control as a logical team mate for an ASME pressure relief valve.

In fact, many local codes now require a low water cut-off, or feeder cut-off combination, on hot water boilers installed in places of public occupancy—including multiple dwelling units.

Notice the diagrams of recommended installations opposite. For more detailed discussion get this booklet that tells the whole story: "Basic Safety Controls for Hot Water Space Heating Boilers."

The What-Why-How in eight interesting pages
Write for Bulletin P-30C



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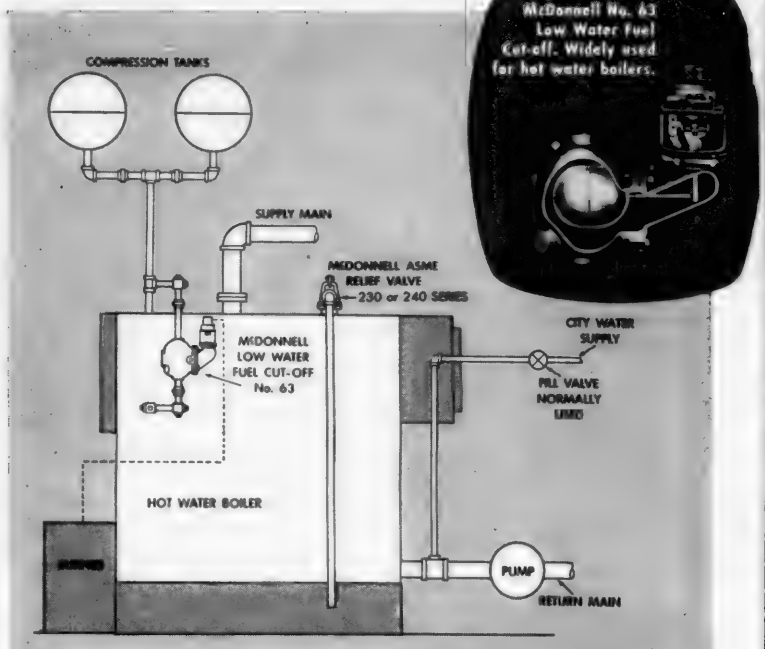
McDonnell No. 63 Low Water Fuel Cut-off. Widely used for hot water boilers.
COMPRESSION TANKS
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FILL VALVE NORMALLY USED
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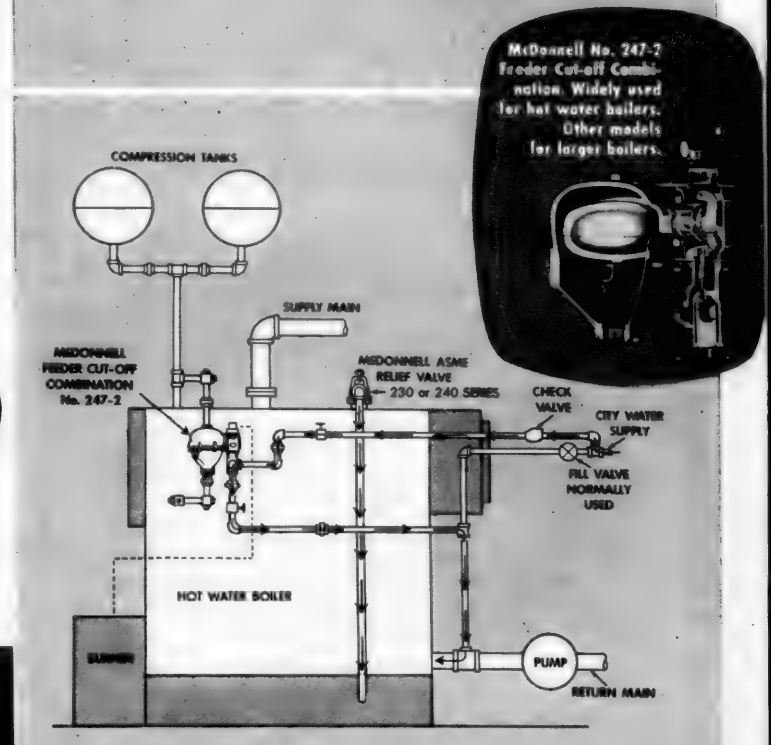
McDonnell No. 247-2 Feeder Cut-off Combination. Widely used for hot water boilers. Other models for larger boilers.
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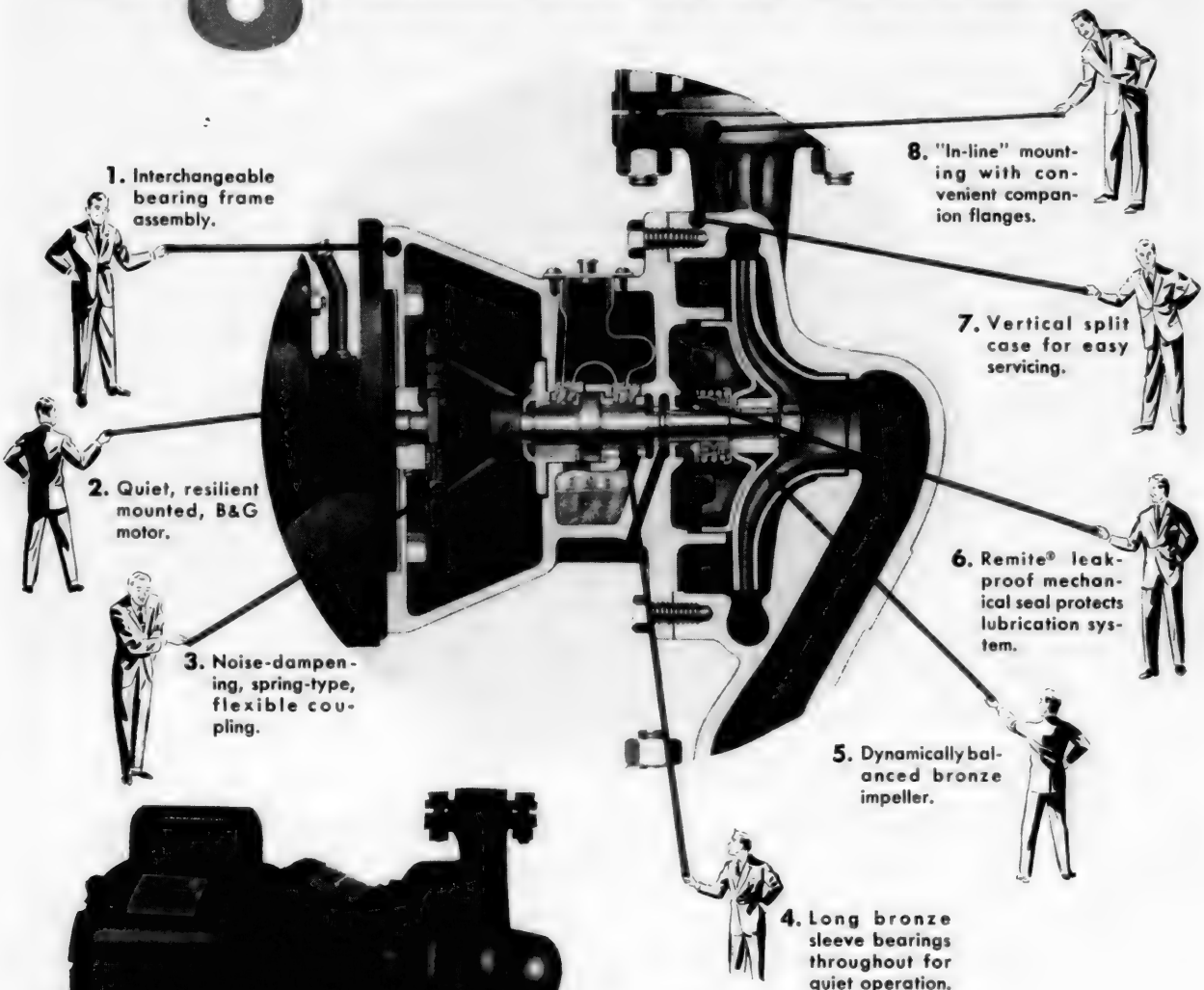
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This new "in-line" pump has all the inherent features of B&G Booster and Universal Pumps which have been accepted as standards for quiet operation. The compact design of the Series 60 saves space... vertical split case construction and interchangeable parts permit easy servicing... in-line mounting simplifies installation.

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Series 60 Pumps are carried in factory stock as bronze fitted units in four sizes, with heads to 29 ft., capacities to 100 GPM, working pressures to 175 psi. When built to order, they are available as all-bronze, all-iron and bronze-fitted units. Both stock and built-to-order units operate at 1750 RPM.

As presently manufactured, Series 60 Pumps from stock can be installed only in a vertical position. If horizontal mounting is required it must be so specified on order.

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Chemical Eng. Bldg. at left; Mechanical Eng. Bldg. at center; Main Research Bldg. at right.

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JENKINS VALVES assure trouble-free control of the entire piping system

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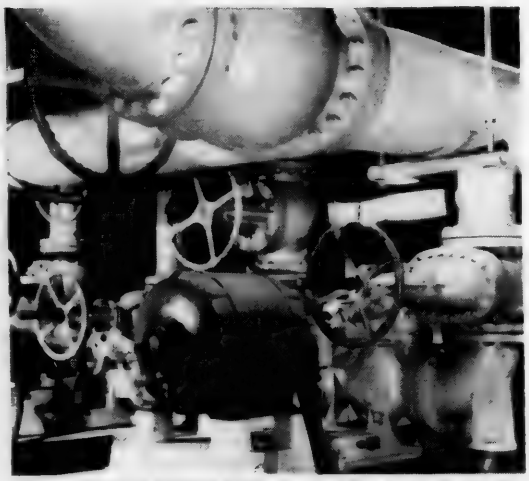
Make the specification "JENKINS" *your* safeguard against valve trouble and the high cost of valve maintenance. *You pay no more* for Jenkins Valves. Jenkins Bros., 100 Park Ave., New York 17.



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In a wet, cold, foreign country

...**Gilsulate** poured-in-place insulation and ...A leading prefabricated steel case piping insulation were tested under identical conditions

Here are the results...

Gilsulate system was less than ½ the cost for the completed installation of the steam and condensate return system.

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Gilsulate resulted in greatly reduced maintenance costs. Leaks in piping can be easily located and repaired. GILSULATE requires no casing, which is subject to damage and corrosion, to keep it dry.

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The insulation for superior protection of underground hot pipes

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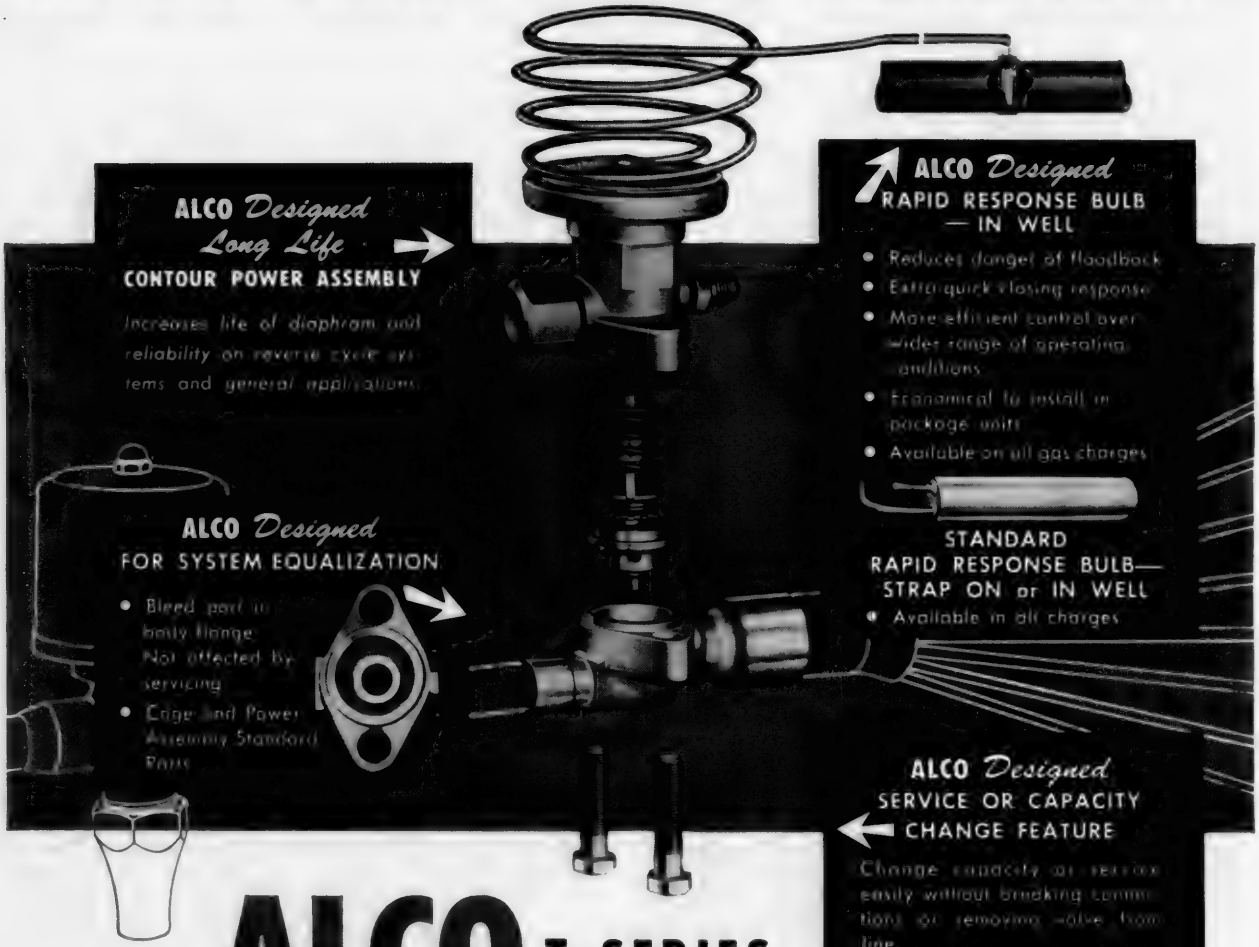

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Long Life
CONTOUR POWER ASSEMBLY

Increases life of diaphram and reliability on reverse cycle systems and general applications.

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RAPID RESPONSE BULB — IN WELL

- Reduces danger of floodback
- Extra quick closing response
- More efficient control over wider range of operating conditions
- Economical to install in package units
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STANDARD RAPID RESPONSE BULB— STRAP ON or IN WELL

- Available in all charges

ALCO *Designed*
FOR SYSTEM EQUALIZATION

- Bleed port in body flange. Not affected by servicing
- Cage and Power Assembly Standard Parts

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SERVICE OR CAPACITY CHANGE FEATURE

Change capacity or service easily without breaking connections or removing valve from line.

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• For R-12 from ½ ton to 50 tons, R-22 from 1 ton to 80 tons, R-500 from ¾ ton to 60 tons. SELECTIVE CHARGES AVAILABLE • BODY DESIGNS — STRAIGHT THRU or ANGLE STYLE • EXTERNAL or INTERNAL SUPERHEAT ADJUSTMENT • TIGHT SEATING . . . STAINLESS STEEL STEM AND SEAT . . . • HERMETIC TYPES ALSO AVAILABLE.

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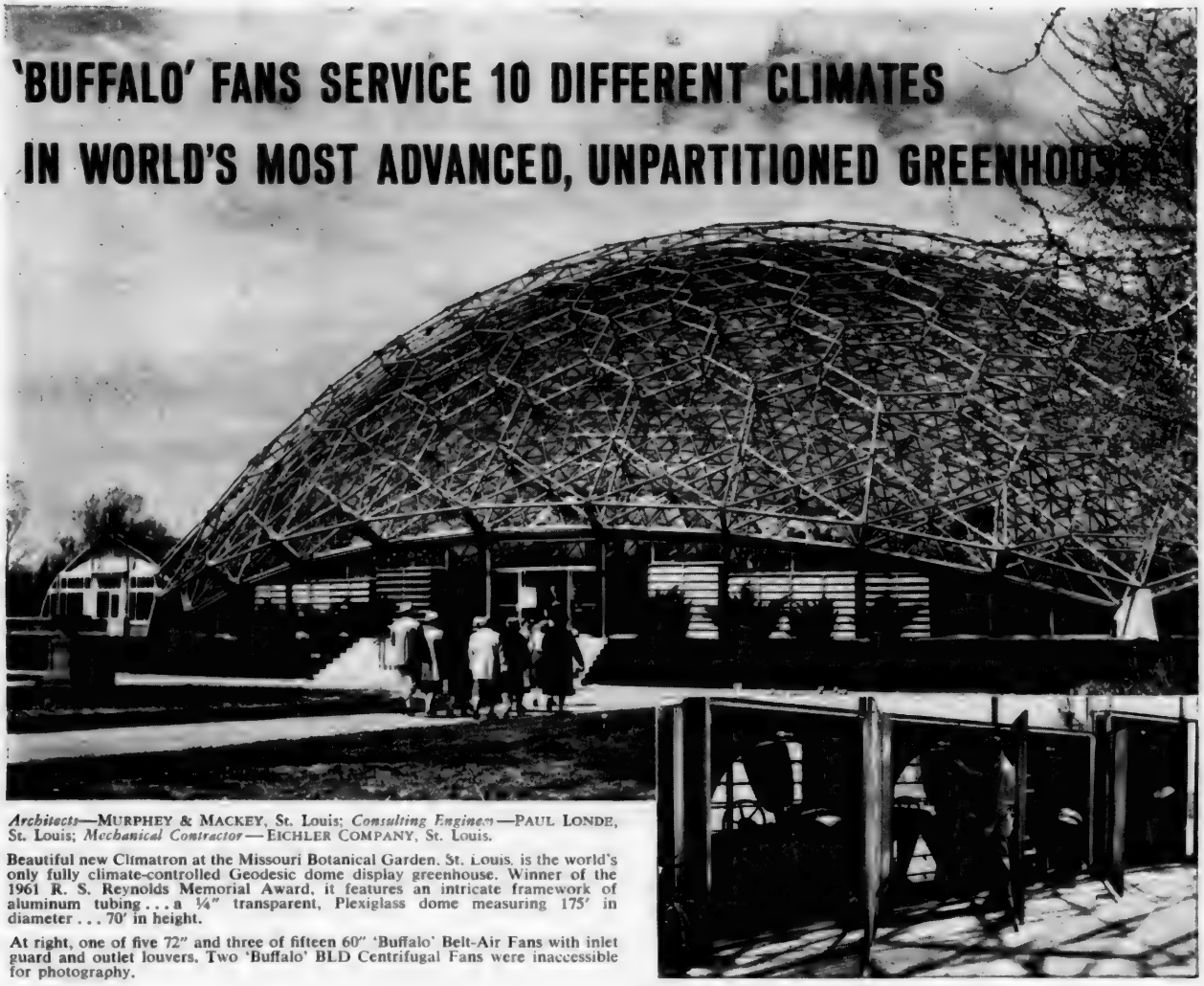

Architects—MURPHEY & MACKEY, St. Louis; *Consulting Engineer*—PAUL LONDE, St. Louis; *Mechanical Contractor*—EICHLER COMPANY, St. Louis.

Beautiful new Climatron at the Missouri Botanical Garden, St. Louis, is the world's only fully climate-controlled Geodesic dome display greenhouse. Winner of the 1961 R. S. Reynolds Memorial Award, it features an intricate framework of aluminum tubing . . . a ¼" transparent, Plexiglass dome measuring 175' in diameter . . . 70' in height.

At right, one of five 72" and three of fifteen 60" 'Buffalo' Belt-Air Fans with inlet guard and outlet louvers. Two 'Buffalo' BLD Centrifugal Fans were inaccessible for photography.

The award-winning Climatron above was a challenge unique to the air conditioning industry.

Scheduled for close proximity growth in the vast 1,300,000 cubic foot room were a steaming, lowland jungle; cool Hawaiian garden; misty tropical mountain forest; plus rice, coffee, tea and rubber "plantations."

To assure native conditions and proper growth for these exotic plants, five different temperature and humidity zones were required in the daytime . . . five at night. All in all, *ten different climates in a ¾ acre, unpartitioned area.*

Twenty 'Buffalo' Belt-Air Fans were chosen to induce precisely-controlled climates through precisely-defined areas, in the precise flow required. For winter and nightime use, two 'Buffalo' BLD Fans with thermostatically controlled variable inlet vanes were selected to provide the correct amount of air to heating and humidifying systems. When required, the fifteen 60" and five 72" 'Buffalo' fans can make a complete change of air (1,300,000 cubic feet) in just two minutes . . . without disturbing the 80°F., 85% RH temperature/humidity balance.

This is just one more example of how 'Buffalo' fan engineering versatility can be used to unique advantage throughout industry and commerce.

"Buffalo"

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BUFFALO FORGE COMPANY

Buffalo, New York

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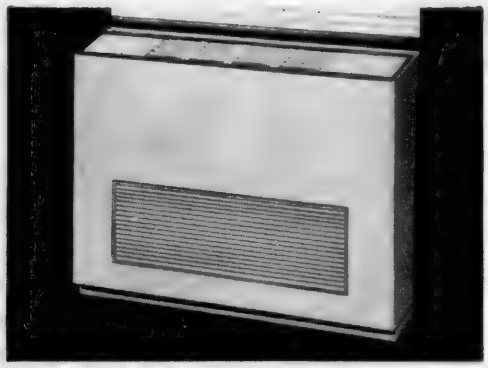
'Buffalo' Air Handling Equipment to move, heat, cool, dehumidify and clean air and other gases.

'Buffalo' Machine Tools to drill, punch, shear, bend, slit, notch and cope for production or plant maintenance.

'Buffalo' Centrifugal Pumps to handle most liquids and slurries under a variety of conditions.

Squier Machinery to process sugar cane, coffee and rice. Special processing machinery for chemicals.



NEW CARRIER UNITS INSTANTLY PROVIDE COOLING OR HEATING IN ANY ROOM AT ANY TIME OF THE YEAR

...can be installed for heating only, with slide-in cooling section added at low cost at any future date

...are easy to install—require no ducts or insulated piping

...save floor space—extend into room only 8 inches; need no apparatus room, no cooling tower

...operate at low cost, summer or winter. Can be turned off in unoccupied rooms

...one thermostat automatically controls temperature—gives heating or cooling instantly when needed.

...heating supplied by steam or hot water. Can be all-electric with strip heating or heat pump

Designed to meet the needs of motels, hotels, apartments, hospitals and smaller office buildings, the new Carrier Four-Season Weathermaker* consists of centrifugal fans with a single row heating coil—either steam, hot water or electric strip. A cabinet mounts on the wall over the fan-coil section. The self-contained, air-cooled refrigeration section slides into a sleeve that extends through the exterior wall. A thermostat and 4-position fan switch are included in the fan-coil section to automatically control both heating and cooling. For complete information, call the Carrier dealer listed in the Yellow Pages. Or write Carrier Air Conditioning Company, Syracuse 1, New York.

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Carrier Air Conditioning Company

Test this actual sample!

FLAME-BAR

New J-M pipe insulation vapor barrier jacket that **WON'T CARRY FIRE!**

3-PLY CONSTRUCTION. Outer ply of 35-lb. white bleached embossed kraft . . . bonded with flame-extinguishing adhesive to aluminum foil . . . reinforced with strong, inorganic fiber glass yarn on 1/6" centers in both directions.

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EASY MAINTENANCE. Washable surface doesn't discolor with age, but can be painted if desired. Stays wrinkle-free. Resists puncturing and tearing. No pinholes.

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NEW FLAME-BAR JACKET IS NOW AVAILABLE ON ALL SIZES OF THESE J-M PIPE INSULATIONS TO GIVE CONTINUITY OF APPEARANCE ON A JOB.

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Expanded Silica (rigid)

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(Kraft exposed)
Flame Spread 25 Fuel Contributed 10 Smoke Developed 15
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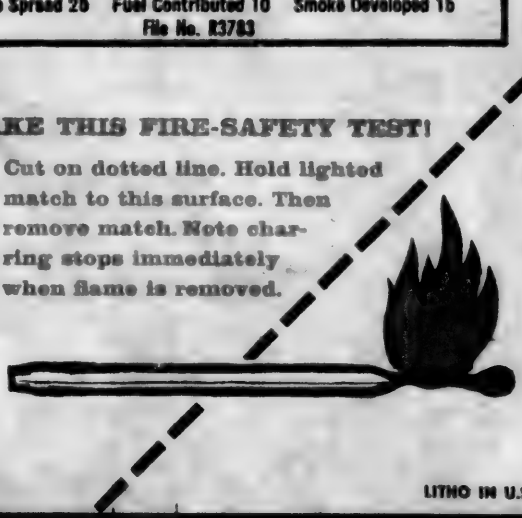
MAKE THIS FIRE-SAFETY TEST!

Cut on dotted line. Hold lighted match to this surface. Then remove match. Note charring stops immediately when flame is removed.



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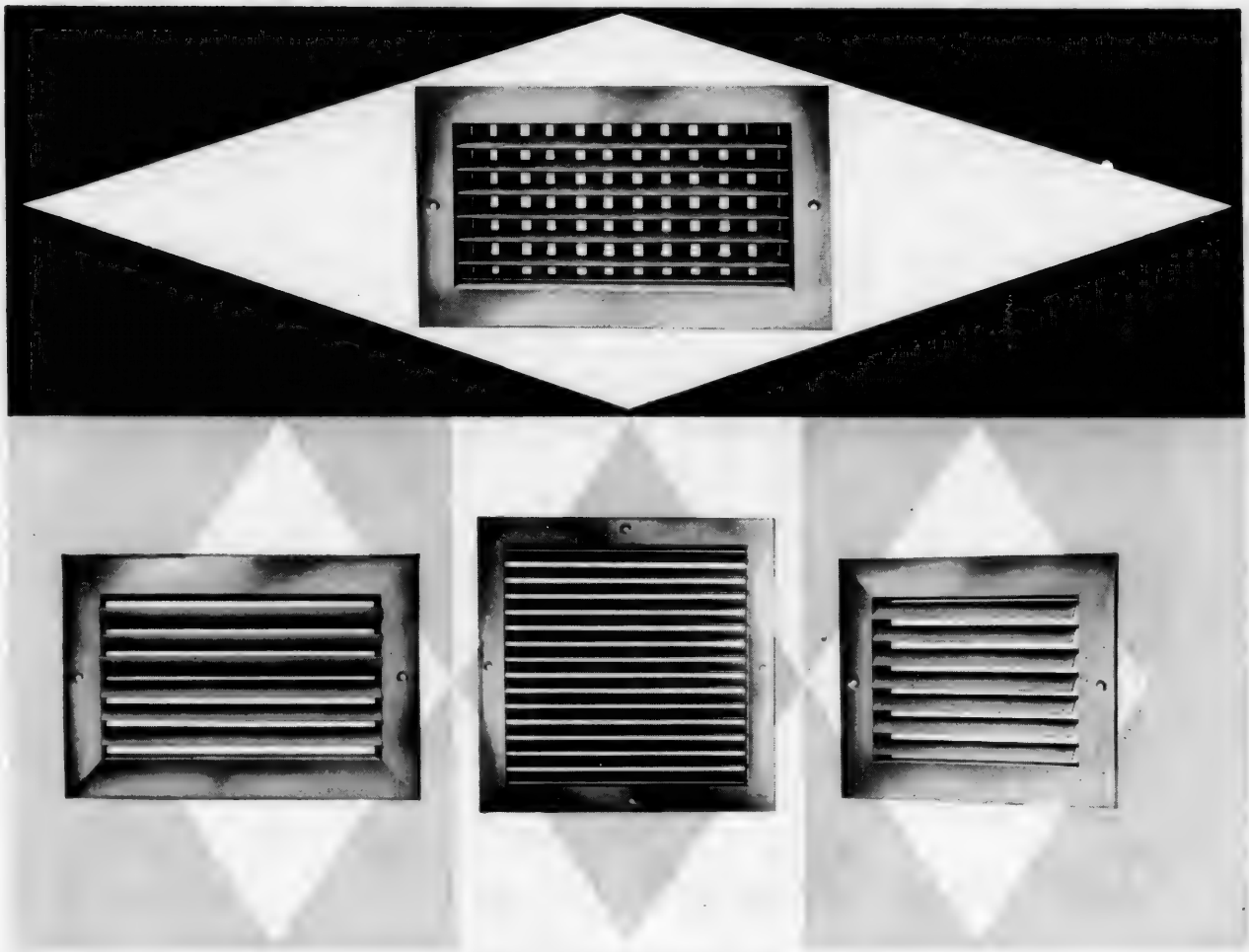
extruded aluminum grilles and registers withstand even salt air environment



YOU CAN COUNT ON STANDARDLINE grilles and registers to retain their "just-installed" appearance even in the most destructive environments. All parts are of extruded aluminum . . . far stronger than rolled aluminum . . . and are impervious to rusting, pitting, corrosion . . . even in salt air.

Surfaces are etched to a rich lustre and coated with a clear acrylic lacquer. The fine finish serves as a perfect base for color-matching grilles and registers to an existing decor, without fear of "bleed-through" or need for a prime coating.

There is a T&B STANDARDLINE grille or register designed to fill the bill for your jobs. For more information, call your nearest T&B Representative or write us direct.

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THIS NEW VACUUM HEATING PUMP

HAS THE INCREASED AIR CAPACITY EFFICIENT HEATING PRACTICE DEMANDS

It's the Nash CSM

Designed and manufactured by the organization that made the Jennings Manifold Heating Pump standard of the Heating Industry, the new CSM incorporates every desirable feature architects, engineers, owners and operators have sought. Employing separate air and water pump elements, each with its own motor and each independently controlled by its own automatic switch, the capacities and arrangement may be widely varied to meet job conditions. For the first time, the engineer has the choice of realistic water and air capacities required for rapid system response without wasteful overheating.

These pumps possess many other features which permit a more efficient utilization of fuel and minimum use of electric power. Low, low returns reduce installation costs and usually eliminate putting the pump in a pit. Simplicity and efficient operation reduce supervision and maintenance costs. Information regarding this new heating pump development is available immediately upon request.

- Increased air capacity induces rapid system response without wasteful overheating.
- Separate air and water pumps individually selected to meet actual job requirements.
- Control system that operates individual pumps only when needed.
- Flexibility permitting addition of radiation without changing basic pump installation.
- Low, low, return line connection.

NASH ENGINEERING COMPANY

437 WILSON, SO. NORWALK, CONN.

Design, Selection and Installation of

REMOTE AIR-COOLED CONDENSERS

Henry B. Williams

Vice-President in Charge of Engineering
McQuay, Inc., Minneapolis, Minn.

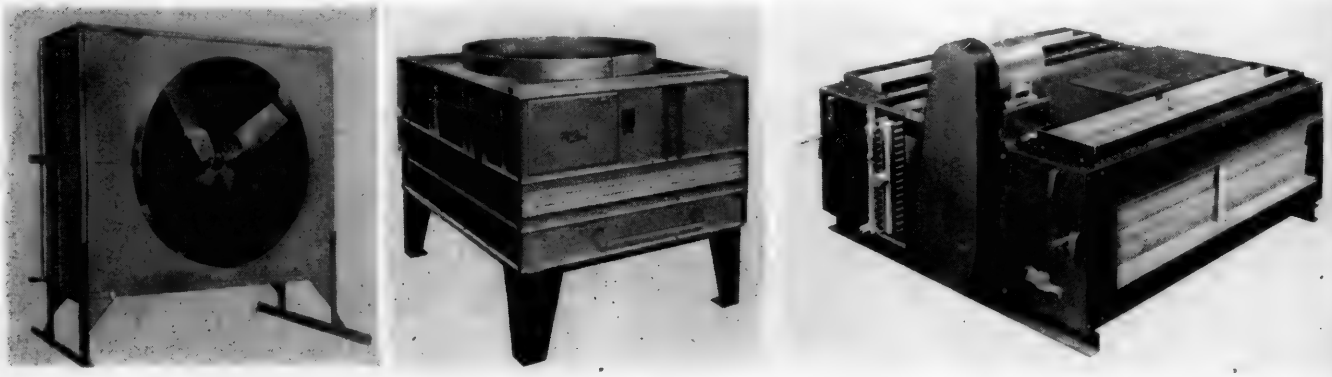
The author details some of the physical features of remote air-cooled condensers which are growing in popularity; discusses ratings, how to select and size a condenser; makes valuable suggestions on the piping, and explains how to overcome head pressure problems.

WITHIN THE LAST DECADE, remote air-cooled condensers have grown greatly in popularity. There are several reasons for this. First is the growth and acceptance of air conditioning; second, the rapid strides in the frozen food field have resulted in a need for far more frozen food processing, storage and merchandising equipment; third, there has been a gradual but solid swing from neighborhood retail food stores to large supermarkets requiring much refrigeration for both air conditioning and for refrigeration and freezer equipment, and finally, there is the water supply, extremely critical in some parts of the country, less so in others, but a factor to be considered at all times and in all areas.

Design

An air-cooled condenser usually consists of the following: (1) a finned tube coil which has been cleaned, dehydrated, and sealed, (2) fan, (3) motor with belt drive where required, (4) unit casing, and (5) legs or means for supporting unit. The unit might be defined as a factory-made encased assembly, intended for connection in the field by means of refrigerant piping, which includes means for forcing air circulation and elements by which heat is transferred from refrigerant to air and the purpose of which is to condense refrigerant vapor by rejecting heat to the air. Typical units are shown in Fig. 1, below.

Fig. 1. Three types of remote air-cooled condensers. Left, a horizontal flow unit with axial-flow fan. Center, a vertical flow unit with axial flow fan. Right, a horizontal unit with centrifugal blower.



The gross heat rejection effect of a remote air-cooled condenser is the total heat removed from the condensing refrigerant. This value is equal to the product of the weight of refrigerant flow and the difference in enthalpies of the entering refrigerant vapor and the leaving refrigerant liquid, expressed in Btu per hour. The gross heat rejection effect, for all practical purpose, is the net refrigeration effect in the evaporator of the system plus the heat added to the refrigerant by the refrigerant compressor.

When condensing temperature is referred to, it is intended to mean the saturation temperature (in deg F) corresponding to the refrigerant pressure at the condenser inlet. Entering air temperature is the average air temperature (in deg F) at the inlet side of the condenser; this would normally be considered the ambient temperature. The temperature difference (TD) is the difference between the condensing temperature and the entering air temperature.

Air-cooled condensers have been used for many years as a part of a condensing unit. However, their application as *remote-mounted* condensers is a comparatively new development and was originally confined to small sizes, whereas today, air-cooled condensers are usually limited in size only by shipping restrictions.

The finned tube coil in the condenser can be made of several different tube sizes and with several fin spacings. The selection of the proper tube size and fin spacing is usually determined by the economics of the design. Small tubes will require a greater number of refrigerant circuits than with larger tubes. The fin spacing is governed by a requirement to keep the air pressure drop in the coil to a point that will not penalize the fan or the fan motor to be used. Generally, fin spacings are in the range of six to twelve fins per inch. Fin spacing can also have some bearing on how quickly the condenser coil can become fouled by dirt. The depth of coil, or number of rows in the direction of air flow, is also a factor in the design controlled by physical dimensions and economics.

The fan selected is usually (not always) of the propeller type and is directly connected to the motor on the smaller size units and driven by a V-belt drive on the larger units. Units are designed for horizontal or vertical air flow and with adjustable legs which permit some variation in the mounting height.

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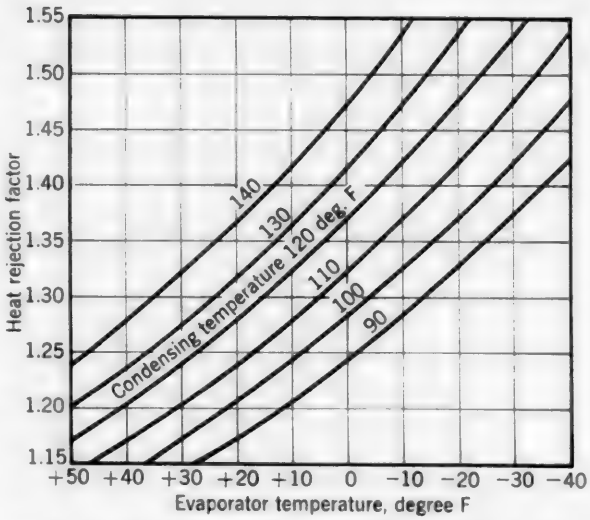


Fig. 2. To determine the total heat rejection to size the condenser, multiply the compressor capacity (net refrigerating effect) by the heat rejection factor found on the curve from the intersection of the proper evaporator and condensing temperatures.

Centrifugal fans can also be used and are particularly desirable when the air to and from the condenser is to be ducted. Also, the centrifugal fan has the additional advantages of low silhouette and, in many cases, is quieter in operation.

Ratings

The engineer must have available reliable heat transfer data covering various types of heat transfer surface that the manufacturer can produce. These basic heat transfer or coil rating data are based on laboratory tests and are normally put into graph form from which it is a relatively simple job to determine the best coil to be used for the specific rating desired. The engineer must also base his ultimate design on certain basic standards for remote air-cooled condensers. Although an industry standard is not currently available for these remote type units, present accepted practice is the publishing of ratings converted to the evaporator capacity at 40 deg F, condensing temperature of 120 deg and 90 deg entering air temperature. Most ratings for compressors show only the evaporating or the net refrigeration effect rating. However, the condenser must, in addition, absorb the heat of compression, so that the gross heat rejection effect must be considered. In the absence of specific data for a compressor, Fig. 2 can be used to determine the additional allowance. That is, the factor to the left in Fig. 2 is multiplied by the net refrigerating effect to determine the total load on the condenser.

Obviously, the condensing temperature must be higher than the design ambient temperature. The air entering the condenser has its temperature increased as it passes through the condensing surface and finally leaves the condenser at a temperature which is approaching the condensing temperature.

Good design practice here would call for the leaving air temperature to approach the condensing temperature by approximately three to seven degrees at a 20 deg. temperature difference (TD). A larger air volume would, of course, lessen the approach, or this can be accomplished with more surface.

With the desired air volume determined, the engineer will select the particular coil to be used, giving consideration to coil tube size, fin spacing, coil face area, and coil depth in the direction of air flow. As previously mentioned, fin spacings generally range from six to twelve fins per inch. With the use of modern rippled fins, it appears that the closer fin spacings actually make the coil less less prone to become quickly fouled by dirt. The coil face velocities used are normally in the range of 500 to 800 feet per minute. The final determination of the coil depth also is related to the air velocity and the fin spacings selected. All of these variable factors must be checked with the brake horsepower requirement of the fan, and, thus by proper consideration to each factor, the designer produces an air-cooled condenser which meets design criteria as well as economic requirements.

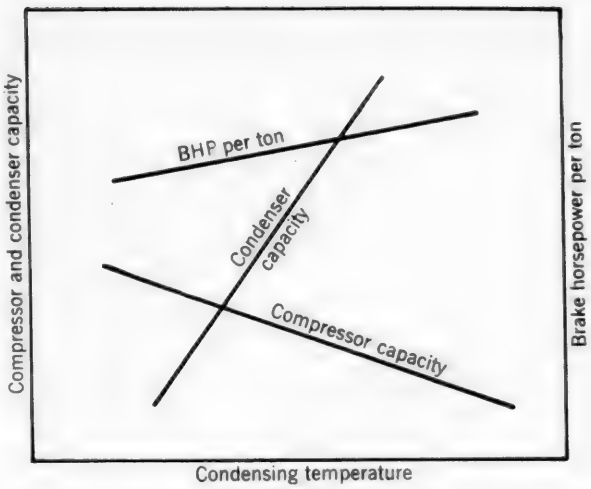


Fig. 3. As condensing temperature increases, condenser capacity increases, compressor capacity decreases, and brake-horsepower per ton of refrigerating effect increases.

Selection

In the selection of the proper air-cooled condenser for a specific condition, there are five factors which should be taken into consideration. These factors can be listed as follows:

1. The compressor capacity (based on the desired evaporator temperature and desired condensing temperature) and the actual condensing temperature at which the air-cooled condenser and the compressor will balance. At this point, we should give serious consideration to the fact that, as the condensing temperature increases, the evaporating capacity decreases and the brake horsepower per ton of refrigerating effect increases (Fig 3). The owner of the system will be the one who will pay higher power bills and receive less capacity if the condensing temperatures are excessive.

   When the air-cooled condenser is selected on the basis of the actual compressor capacity, the compressor can operate for an extended period at a capacity that could be considered higher than the design capacity. If the air-cooled condenser is selected on the basis of the design load, a compressor which has a capacity greater than the design load will balance the condenser at a higher condensing temperature at the design ambient temperature. This is a very important consideration which, if overlooked, could cause operating difficulties. As an example, if the increase in compressor capacity is so great that the higher condensing temperature results in compressor motor overload or compressor cycling on high head, it would be important to select the next larger air-cooled condenser.

2. The proper design temperature difference is extremely important to the proper selection of an air-cooled condenser. Weather bureau data for the area concerned should be studied so that the proper dry bulb temperature is selected for remote outdoor air-cooled condensers. The maximum temperature ever encountered in the area need not necessarily be used as the design temperature, but it certainly is in order to use the maximum temperature that is normally encountered. With the proper entering air temperature determined, the desired condensing temperature can be found by using the temperature difference (TD) indicated by the simple calculation TD = condensing temperature — entering air temperature. The temperature difference normally used would be from 10 to 30 deg. However, the correct TD for a particular unit selection is based on the desired condensing temperature and the entering air dry bulb temperature.

   In selecting air-cooled condensers for use in areas where high ambient air temperatures are common, it should be obvious that the selection must be made on a small temperature difference. If this is done and a careful check of the compressor condenser balance is made, there is no reason why an air-cooled condenser system cannot be completely satisfactory from a performance and economic standpoint. If the system is to operate at night hours only, serious consideration should be given to the fact that the dry bulb temperatures are then lower, and, therefore, the condensing unit can be selected to operate at lower condensing temperatures.

3. The proposed location of the condenser would have an effect on the style or type air-cooled condenser selected. If the unit is to be installed on the roof of a low building, it would be desirable to use a horizontal type unit with vertical air flow. This unit arrangement normally has a much lower height dimension which then gives a more pleasing silhouette on a low building. Some locations of the condenser would require a vertical type unit with horizontal air flow; this could be

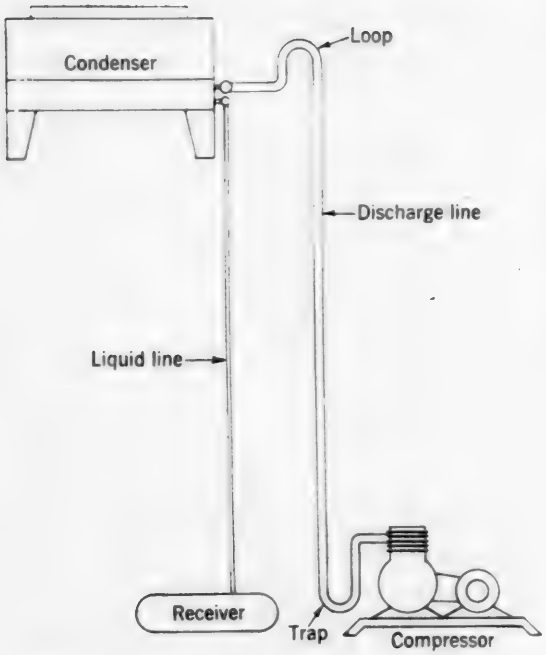


Fig. 4. Poor arrangement of piping to condenser on roof. If discharge line is sized for peak operation, velocity at reduced loads will be too low to carry oil up through the coil. If discharge is sized for reduced loads, excessive pressure drop would result at full loads. One method of correcting this is to size discharge line for full load, install an oil separator at the bottom of the trap near the compressor. The liquid line here is correct — it has plenty of vertical distance between condenser and receiver.

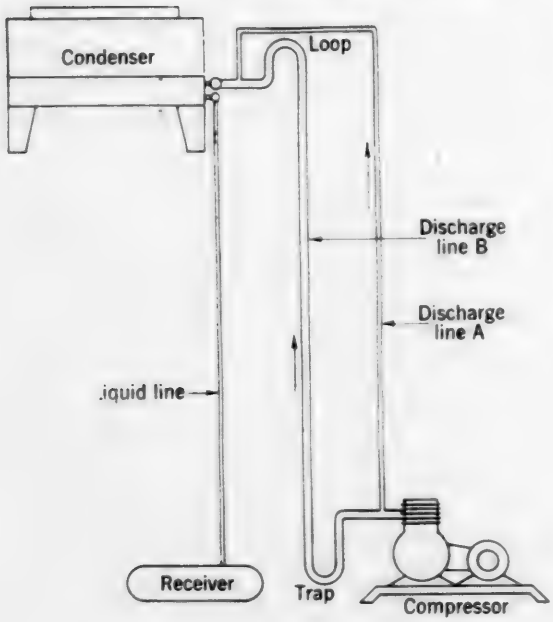
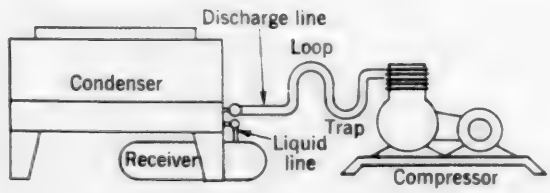


Fig. 5. A second way to correct the piping shown in Fig. 4 is to run two discharge lines, as shown. A should be sized to carry oil at minimum loads, B so that at full loads both A and B will carry oil.

Fig. 6. Where the condenser and compressor are on almost the same level, as here, the problem is that there may be poor drainage of liquid refrigerant to the receiver. Be sure the height between the condenser and receiver is as much as possible with no traps or loops in the line, and with as much pitch as possible in any horizontal runs.



particularly true if floor mounting space were at a premium. If the condenser or condensers are located on the roof of a building, give consideration to the ability of the structure to carry the added load. This would be a problem especially where several large condensing units might be mounted in a confined area.

4. The refrigerant to be used is an important selection factor. It is true that the same condenser can normally be used for either Refrigerant-12 or R-22, but, in some cases, the system efficiency can be improved by using a condenser which has been circuited for the specific refrigerant to be employed. The circuiting itself also can be affected by the type of head pressure control to be used, if such is necessary.
5. In selecting a condenser for multiple refrigerant circuit application, it is necessary that several variables be given consideration. These are: (a) the number of compressors to be used, with their capacities at the evaporator temperature required; (b) the specific heat rejection factor (or total heat rejection in condenser) for each compressor; and (c) the total of the individual condensing unit capacities which will determine the total condensing unit capacity required.

Installation

Air-cooled condensers, when outdoor mounted, should always be located in an area where there is no question as to adequate air supply. Air supply can become a problem if a restricted building court area is being considered for the mounting location. Generally, the condenser should be so mounted that its air flow is in the direction of the prevailing wind. Wind deflectors are provided by most condenser manufacturers as an optional accessory which can be used if strong winds can normally be expected from more than one direction. If more than one unit is to be installed, it is very important that they be properly spaced so that one unit would not be picking up the discharge air from another unit. If such a condition existed, it obviously could cause increased condensing temperatures on the unit so affected.

Once the exact unit locations are determined, proper mounting members should be set, and the unit then securely bolted to these members. The unit must be level so that the refrigerant will properly drain from the coil. With the compressor and receiver locations fixed, it now will be necessary to install the refrigerant piping. The recommendations of the manufacturer are particularly important in this area, so it becomes necessary for the installer to follow these recommendations carefully to avoid future operational problems. Line sizing must be based on the unit capacities, and, with this as a base, the sizing should follow current accepted standards.

Three Suggestions as to Piping

A loop should be provided in the discharge line near the compressor before rising to the condenser. This loop prevents the possibility of refrigerant condensing in the hot gas discharge line on off cycles from draining back to the head of the compressor. It also serves as an oil trap to prevent oil draining back to the head of the compressor. Figures 4, 5, 6 and 7 are presented here to aid in correct piping layout.

Gravity drainage should be maintained in the liquid line from the condenser to the receiver. The sizing of this line is important as gas binding can be caused by undersized liquid lines or because of traps in this line. Air, or other non-condensables, also induce gas binding.

The piping should be installed so that it is well supported but with sufficient flexibility to make sure that vibrations from the compressor or condenser are not transmitted to the building. The use of a muffler in the discharge line is sometimes necessary to dampen hot gas pulsations.

Control of Head Pressure

One of the most difficult problems with air-cooled condensers has been to obtain head pressures which are high enough during periods of low outside air temperatures in winter. This is because the capacity of an air-cooled condenser is directly proportional to the temperature difference between the unit's condensing temperature and the ambient temperature. The unit, as previously stated, is normally selected on the basis of 10 to 30 deg temperature difference, but, during winter operation, the temperature difference may increase to 100 deg so that the potential capacity of the condenser may be increased by five, six or more times.

In this case, in order to maintain a balance with the compressor, the head pressure falls off badly. The greatly reduced head pressure causes the operation of the system to be affected. With the reduced head pressure, the pressure drop across the expansion valve may easily drop so low that the valve will have insufficient capacity to handle the evapora-

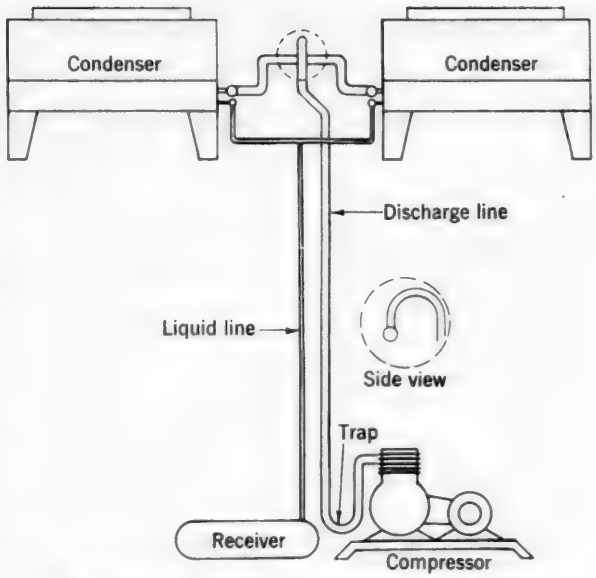


Fig. 7. Piping where two condensers are used with one compressor. In this case, condensers must be of same capacity, and piping run to each should be of identical length. Note loops in hot gas line to prevent oil and condensed refrigerant from flowing back to compressor.

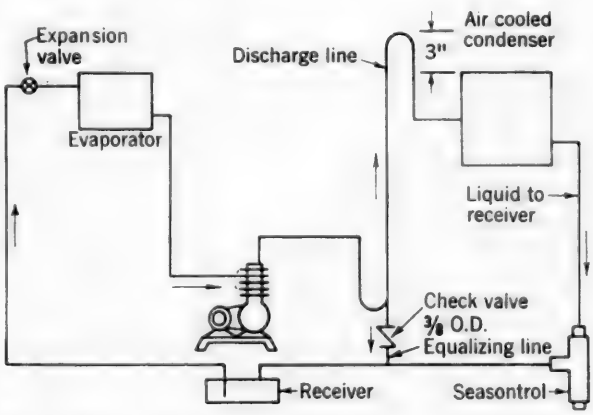


Fig. 8. Control of head pressure by use of the Seasontrol modulating valve which controls the liquid level in the condenser.

SYSTEM PRESSURE DROP WITH 25 TON EVAPORATOR LOAD

	System Under Design Conditions		System with Reduced Condensing Temperature	
Condensing pressure	125		85	
Liquid line pressure drop	6		6	
Pressure at expansion valve inlet		119		79
Suction pressure	37		37	
Suction line losses	3		3	
Coil pressure drop	5		5	
Distributor pressure drop	17		17	
Pressure at expansion valve outlet		62		62
Pressure drop available across valve		57		17

tor load. This condition can readily be illustrated by the above example.

The capacity of a valve rated at 25 tons would, at a 57 psig drop, be 24.5 tons, while its capacity at 17 psig drop would be only 16.0 tons.

Note that the thermal expansion valve capacity is over 50% greater at the higher head pressure. If a nominal 25 ton valve were selected, it would not have sufficient capacity under conditions encountered with the reduced condensing temperature. Expansion valves could be selected to handle the variations in pressure, or the preferred method would be to use a system wherein the head pressure can be maintained at the proper level.

The control of head pressure can be maintained by several types of control. These main types of control are as follows: (1) Cycling fan operation—with single speed fan motor or with two speed fan motor; (2) Multiple fan operation; (3) Control of face dampers covering the face of the condenser coil; (4) Inside installation of the condensing unit, and (5) Control of the liquid level in the condenser.

In addition to these five control systems, the centrifugal fan type unit is adapted to the use of face and by-pass dampers or inlet mixing dampers. The face and by-pass method permits varying the air volume through the condenser coil, while the use of inlet mixing dampers permits the mixing of outside air and recirculated air to control the air temperature entering the coil.

The control of liquid level is very successfully accomplished by the installation of a normally-closed modulating valve in the liquid line between the condenser and the receiver. See Fig 8.

With this particular arrangement, when there are low temperature ambients and a low head pressure, the modulating valve would remain closed until the coil in the air-cooled condenser fills with sufficient liquid to hold the condensing pressure at a fixed minimum. As the outside temperature rises, the condensing pressure and temperature will increase, causing the modulating valve to open and reduce the level of refrigerant liquid in the condenser coil. As the outside temperature falls, the discharge temperature and pressure also tend to fall, causing the modulating valve to close. This raises the level of the liquid refrigerant in the condenser coil, reduces the condensing surface, and re-establishes the equipment balance at the setting of the modulating valve.

With liquid level control, it is necessary materially to increase the refrigerant charge in the system. The additional charge required is based on the minimum air temperature entering the air-cooled condenser. As the air temperature lowers, the refrigerant charge increases. This additional refrigerant charge becomes a very significant factor in low temperature areas. In fact, it can require a charge as much as six or seven times that required for summer operation. The additional charge required for a specific condenser is published by the unit manufacturer. It becomes important to make sure that the refrigerant receiver is sized to hold, in summer, all of the additional refrigerant needed to flood the condenser in winter. The receiver should be of such size that the system can be completely pumped down.

Another practical system for maintaining head pressure is to control the air flow through the condenser. This can be readily accomplished by having modulating face dampers installed on the face of the coil. These dampers would normally be installed on the entering air side of the coil. For best control, it also would be desirable to use a two speed fan motor on the condenser. The controls required for such a system basically consist of a modulating type damper motor, an end switch, and a pressure control. The sequence of control would be approximately as follows, starting with the fan motor off and the dampers closed:

1. As the condensing pressure rises, the damper motor permits the face dampers to modulate open in direct proportion to the rise in pressure;
2. When the dampers are half open, the end switch would make contact to start the fan motor on slow speed;
3. As the damper reaches a full open position, an end switch contact is made which puts the motor into high speed;
4. If the ambient air temperature begins to fall, thus lowering the head pressure, the controls will function in reverse manner to close the dampers and reduce the fan motor speed, and so on.

When properly selected, an air-cooled condenser will operate at a low cost, and sometimes at a lower cost than any other condensing system. The outstanding advantage of the remote air-cooled condenser is reduced maintenance because of the simplicity of the unit and the complete elimination of water. It is reasonable to predict that the next several years will see an increasing growth in the use of remote air-cooled condensers for air conditioning and refrigeration applications.

Condensation problem is solved with new method for

Swimming Pool Design

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Associate

and

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New York, N. Y.

To simplify calculations and analyses in heating and ventilating design for indoor heated swimming pools, the authors developed a series of tables and charts. Part 2 of a two-part series.

IN PART I OF THIS ARTICLE*, the possibilities of using outside air of lower specific humidity than inside air to maintain adequate comfort conditions and control condensation were explored. How a space would be maintained at 80 deg F and 60% rh was shown by example. However, it is important to note that this is possible only when outside air is available at 80 deg or below and with specific humidity below design inside specific humidity. Otherwise, air conditioning is required.

This article covers ventilation only. See Table 3.

From the formulas

$$W = \left(\frac{95 + 0.425v}{\gamma}\right)(A)\ (p_w - p_a) \text{ and}$$

$$\text{CFM} = \frac{1560\,W}{\Delta G} \text{ (misprinted } \frac{156\,W}{\Delta G} \text{ in Part I)}$$

the charts given in Part I were developed. With them, the engineer can approximate, quickly, from a wide range of design outside conditions, required ventilation air quantities.

Example 1 indicated the variability of required air quantities:

At 0 deg outside, CFM =

$$\frac{1560\,W}{\Delta G} = \frac{1560 \times 83.5}{89} = 1460$$

At 50 deg outside, CFM =

$$\frac{1560\,W}{\Delta G} = \frac{1560 \times 83.5}{65} = 2000$$

At 60 deg outside, CFM =

$$\frac{1560\,W}{\Delta G} = \frac{1560 \times 83.5}{53} = 2450$$

To satisfy the wide range of requirements, our office has standardized on fan capacities with two-

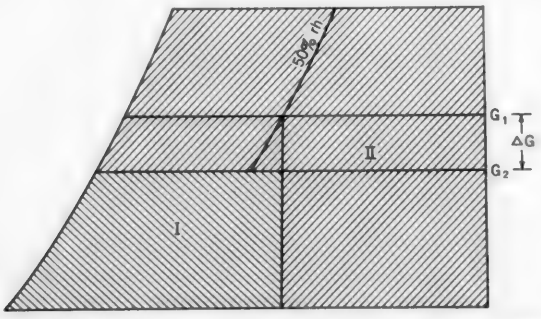
TABLE 3 — FAN DATA FOR SWIMMING POOLS

Maintained at 80 Deg db, 60% rh, with Pool Water at 75 deg, Room Air Velocity of 30 fpm, for Outside Temperatures from —20 to +20 deg.

Pool Water Surface Area, Sq Ft	Approx. Air to Prevent Condensation, Cfm	Fan Capacity, Cfm**		Δ G*
		Low-Speed Operation	High-Speed Operation	
1000	450-550	1800	3600	11
2000	900-1100	3600	7200	11
3000	1350-1600	4000	8000	15
4000	1800-2100	4000	8000	20

* Indicates approximate difference, in grains, between space and outside air. All outside temperatures having specific humidies less than the difference between the room specific humidity and the differential humidity in this column, and which is less than 80 deg, will maintain room condition of 80 db and 60% rh. Diagram below indicates estimated range of conditions.

** Two-speed motors are provided on both supply and exhaust fans; the high speed being used during times of spectator activity and Spring months.



Region I, bounded on right by 80 db, is area in which outside air needs no refrigeration.

* AIR CONDITIONING, HEATING AND VENTILATING, May, 1961, pp 81-86.

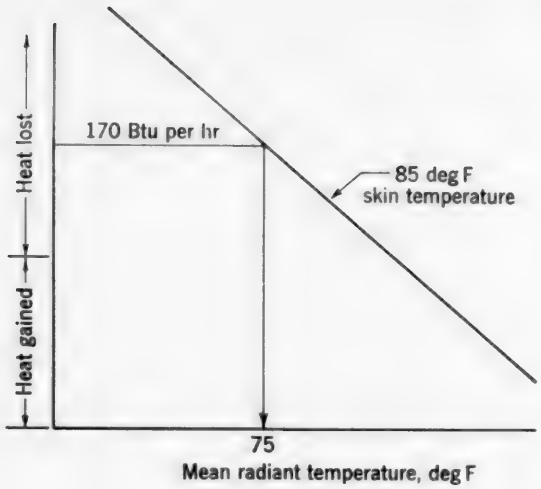


Fig. 5. With an average skin temperature of 85 deg F assumed, the straight-line curve above shows how heat loss or gain from the skin, by radiation, varies as mean radiant temperature of pool enclosure changes. For further information on this subject, see References 7, 8, 11, and 15.

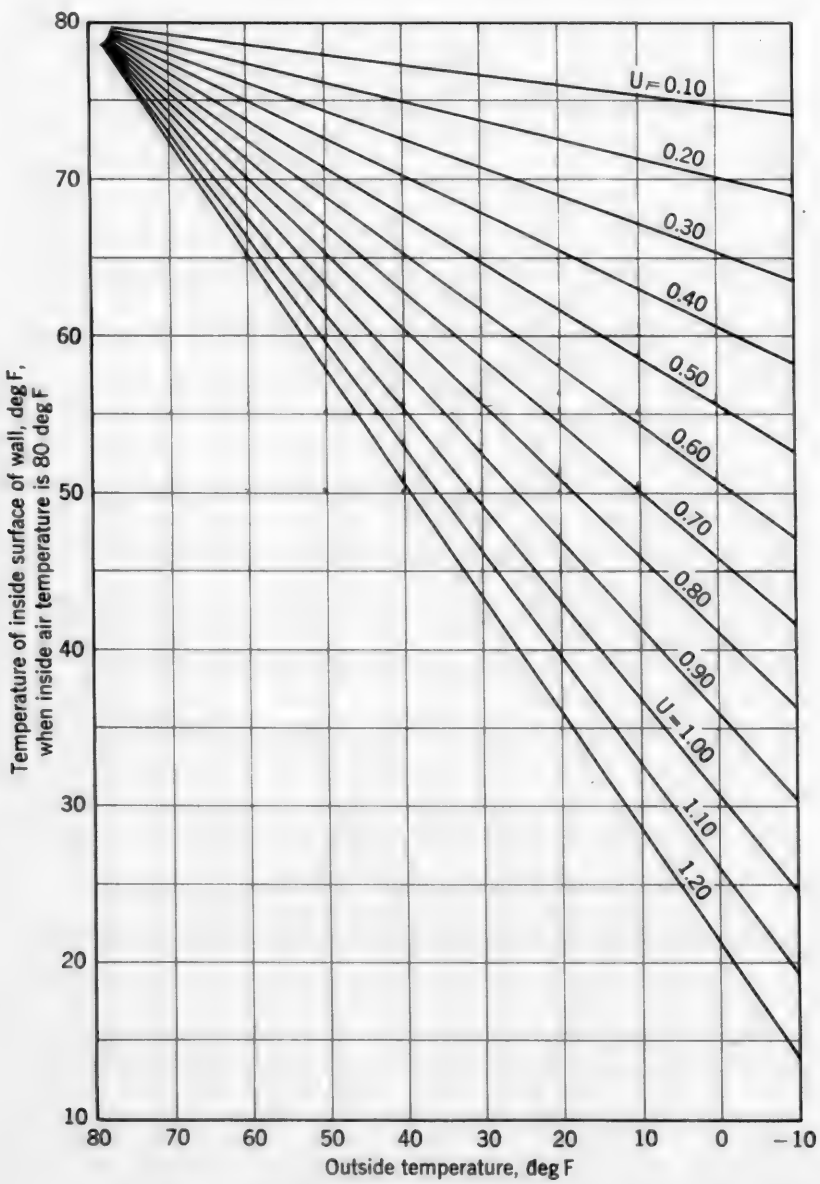


Fig. 6. Chart gives inside wall surface temperatures at various outside air temperatures when pool air temperature is held at 80 deg F.

speed motors for various outside design temperatures and pool water surface areas. See Table 3.

Selection of Building Components

Solution of environmental problems occurring in design of indoor recreational swimming pools requires an analysis of the materials of construction and their proper application. Selection of outside walls, roof or ceiling, interior walls and floor construction demands close-coordination of architect and engineer.

Construction elements (walls, roof, floor, etc.) must be so selected and arranged that their overall coefficient of heat transfer (U) will be such that:

(a) inside surface temperature is high enough to prevent visible condensation,

(b) temperature and vapor pressure drops across each constituent part does not incur concealed condensation within the wall, and

(c) a mean radiant temperature (MRT) of 70 to 75 deg will be maintained at all pool surfaces, including water surface. This will keep heat loss by radiation from the unclothed swimmer to his surroundings to a minimum, avoiding the discomfort of chills associated with radiation to cold surfaces.

Comfort

Studies by Keeton, et al, Dubois and Hardy, on comfort ranges for nude men agree on an optimum Effective Temperature of 75. This is in conformity with the recommended inside design condition of 80 db and 60% rh.

The body loses heat by radiation, convection, evaporation and the respiratory process. At 80 deg, DuBois' study indicates, losses are approximately as follows:

Radiation	170 Btu per hr
Convection	50 Btu per hr
Evaporation and Respiration	100 Btu per hr
	320 Btu per hr

It was found also that skin temperature is approximately 90 deg when the room temperature is 80 deg. Figure 5 shows that as MRT decreases, body heat loss increases. Therefore, if it is desired to maintain the normal balance of 170 Btu per hr loss by radiation at 80 deg, it is important to keep MRT of surfaces as high as practical. Using an average body surface temperature of 85 deg and a 170 Btu per hr heat loss, an MRT of 75 deg would be desirable.

Pool water is maintained at 75 deg; therefore, its surface temperature is 75 deg. Thus, the problem is to maintain the temperature of all other surfaces at 75 deg. Figure 6 permits the estimation of the required overall coefficient of heat transfer, U, at various outside temperatures, to give the required surface temperature. At 0 deg outside, 80 deg inside, and 75 deg surface temperature required, Fig. 6 indicates that U must be 0.10. This would satisfy both (a) and (c) of the requirements for a satisfactory U coefficient outlined earlier.

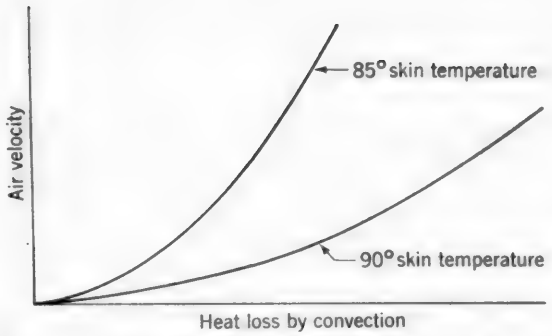


Fig. 7. Variation of heat loss from the body by convection with changing air velocity.

If space temperature is to be maintained at other than 80 deg, U can be calculated from

$$U = \frac{(T_i - T_s)\ (1)}{(T_i - T_o)\ (R_f)}$$

where T_i = Inside air temperature, deg F,
T_s = Required surface temperature, deg F,
T_o = Outside air temperature, deg, F, and
R_f = Inside air film coefficient.

Figure 7, which shows how body heat losses increase with increased air velocity, illustrates the importance of keeping air motion within the pool to a minimum.

With proper MRT and minimum air motion, only concealed condensation remains to be checked.

Properties of Water Vapor

Effective condensation control requires effective control of vapor transmission. Water vapor is low-pressure steam and behaves like a perfect gas in many respects, expanding and contracting to fill, exactly, the space in which it is confined. The maximum (saturation) amount of vapor in a given space is a function of temperature; the greater the temperature, the greater the amount of vapor.

The more vapor in a given space, the greater is its pressure. Thus, it tends to migrate from regions of greater to regions of lesser concentration. Rate of flow depends on the pressure differential and the permeability of the structural components.

Water vapor is formed by evaporation from the pool surface. If pool air is maintained at 80 deg and 60% rh, the vapor pressure in the space above the pool is 0.6192 inches of mercury. If, outside, the (design) temperature is 0 deg and 100% rh, its corresponding vapor pressure is 0.0376 inches of mer-

cury. Hence, the driving force causing migration would be 0.5816 inches of mercury, or 38 pounds per square foot.

Prevention of Concealed Condensation

Surface condensation is prevented when a *U*-factor is selected that maintains inside surfaces above the air dew point temperature, as discussed in connection with Fig. 6 earlier.

Concealed condensation, in those cases where it is liable to occur, can be prevented by enclosing the pool in a vapor-tight envelope. The possibility of concealed condensation should be carefully investigated, as its presence causes plaster to crack, brick to deteriorate, roofs to buckle, paint to blister, and metal structural members to corrode. Further, many types of thermal insulation lose their insulation value if wetted.

The vapor barrier is placed on the warm (room) side of any insulation. Temperature drop and vapor pressure drop should be so arranged that the temperature at all points in the structure should always be above the dew point of their ambients.

Types and applications of vapor barriers are many and complex. The reader is referred to the bibliography at the end of this article for sources of information on types, effectiveness, and application of vapor barriers. It should be understood, as explained earlier, that with the large vapor pressure differentials that can occur across the insulation, no vapor barrier will be effective unless its joints are sealed tight, with no gaps or openings permitted.

Typical Specification

Following is an example of a typical specification utilized by the office of Joseph P. Wohlpart Associates:

Pool System

(*a*) The two-speed exhaust fan shall be interlocked to operate in conjunction with the two-speed supply fan. When the relative humidity exceeds the setting of a room humidistat, the supply fan and exhaust fan are to start on low speed. High speed operation shall be controlled from a manual switch. When the fan is running, the outside air damper is to open wide. A duct thermostat downstream of the preheat coil shall control a motorized valve to maintain a constant 60-deg preheat temperature. A dual thermostat with one bulb in the outside air and one downstream of the reheat coil shall modulate an automatic steam control valve to maintain a constant fan discharge temperature. A room thermostat located in the pool area shall act as a low limit to facilitate fast warm-up. With the room thermostat satisfied, the reheat valve shall be under control of aforementioned discharge controller. When the fan is off, the reheat valve is to go closed and the preheat valve open.

(*b*) A central clock shall automatically switch from day (80-deg) to night (75-deg) cycles. Room thermostats and humidistats are to be of the lock-shield type, and shall have guards. Thermostats and humidistats in pool area shall be treated with a corrosion resistant spray to prevent rusting.

Pool Converter

A proportioning thermostat with the bulb in the water discharge line leaving the converter shall control two (2) 3″ motorized steam valves in sequence to maintain a constant predetermined discharge temperature. In addition, install a second thermostat in the suction line of the pool recirculating pump which shall operate the above valves should the recirculating water temperature be decreased to a predetermined low limit.

The data hereinbefore presented has been used with satisfactory results. Only through an interchange of ideas can engineering develop. Therefore, the authors would appreciate any comment, or the relating of any experiences on this subject that the reader might have had.

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The Right Impeller

Will Give Lowest Cost Pumping

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The author shows that low net positive suction head and high efficiency are often incompatible and that the pump specifier has a choice between open or closed impellers and between overloading and non-overloading impellers. This is the second of four articles on pump selection by Mr. Pollak.

CENTRIFUGAL PUMPS embody the most desirable characteristics of any machine; simplicity, few moving parts, long life, ease of maintenance, minimum repair, and low cost. Centrifugal pumps are nearly always the least expensive means to move liquids and, in an increasing number of applications, the least expensive to move solids. Yet, unless proper care is taken to match the right pump and impeller to the specific job, more money can be wasted than is saved.

The pump impeller must be matched to the specific set of conditions in the system for best service and lowest pumping costs. Mechanically, there are three areas involved in selecting the right impeller: (1) open or closed impellers; (2) overloading or non-overloading impellers; and (3) high efficiency or low NPSH. With respect to the liquid itself, there are two factors: (1) properties of the liquid to be pumped (its viscosity, specific gravity and vapor pressure); and (2) material entrained in the liquid—solids or gases.

Open or Closed Impellers

In the closed impeller type pump, Fig. 1, the head is generated between two confined walls rotating with the shaft. In the open impeller type, Fig. 2, the head is generated between one wall rotating with the shaft and one stationary wall, usually the casing.

Closed impellers are to be preferred in the great majority of applications facing air conditioning engineers. A closed impeller requires little maintenance or service during its life. Its wearing surfaces are

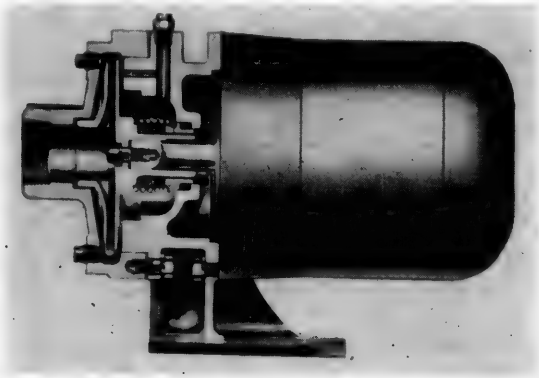

Fig. 1. Closed impeller type centrifugal pump. Head is generated between the two confined rotating walls.

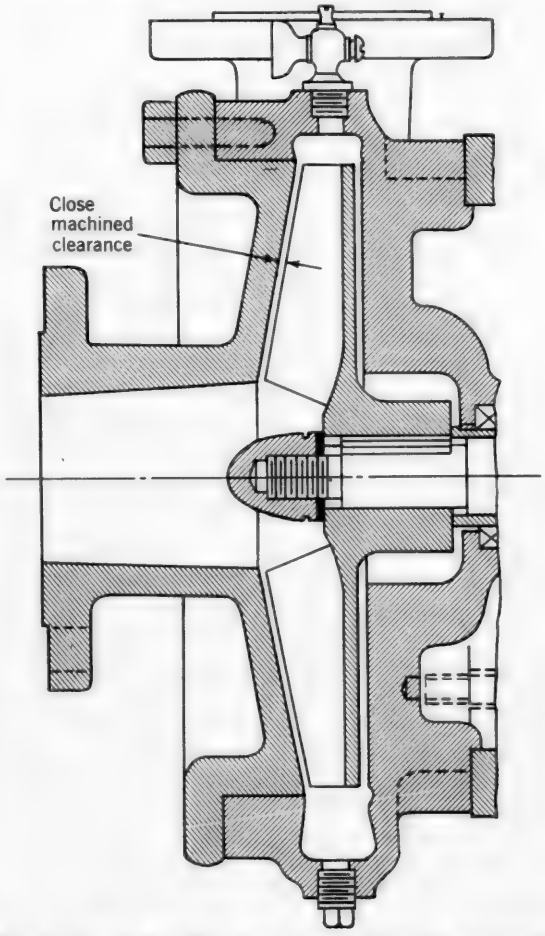

Fig. 2. Open impeller type pump. Head is generated between the rotaing wall and the stationary wall.

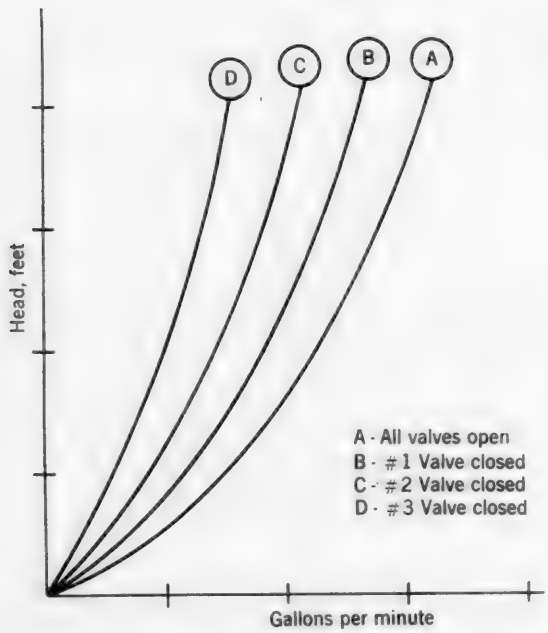

Fig. 3. Valve positions can change the system curve, so that it is difficult to determine the precise operating conditions.

less critical than those of an open impeller and, with nominal maintenance, it retains its original efficiencies over a greater portion of its total life. Although the closed impeller is a more expensive impeller initially, savings in the overall pump cost can more than compensate for this. Running fits and clearances increase with use, but efficiencies do not drop off as rapidly as with the open impeller.

The efficiency of an open impeller is dependent upon maintaining close clearance between the unshrouded side of the vane and the stationary wall that forms the other side of the head-generating passage. Any increased clearances result in large leakage losses and hence lower efficiencies. In addition, these close clearances must be maintained at the periphery of the impeller where erosion and wear are accelerated due to the high surface speeds. Leakage on a closed impeller, on the other hand, is controlled closer to the impeller hub.

The relatively rapid loss of efficiency can be overcome to some extent by providing the open impeller with some method of axial adjustment. This also requires a good maintenance program. Few specifying engineers can control the periodiic servicing and careful adjustments necessary to keep open impeller pumps operating at peak efficiency. Therefore, specify open impellers *only* where they are absolutely essential.

Open impellers are generally required to handle liquids with entrained solids, especially if these solids have a pronounced clogging tendency. An open impeller can handle paper stock, sewage, and other similar mixtures that would quickly clog a closed impeller. If for some reason entrained solids do become wedged against the impeller vanes, an open impeller lends itself to cleaning more readily than a closed impeller.

Non-Overloading Impellers

At times, it may be difficult to determine the exact operating conditions that a system will impose on a pump. Most commonly this is because various valves in the system may be opened or partially or fully closed. The valve positions change the system curve, as shown in Fig. 3.

In addition, the pump might be frequently switched from one piping system to another by valving. Suc-

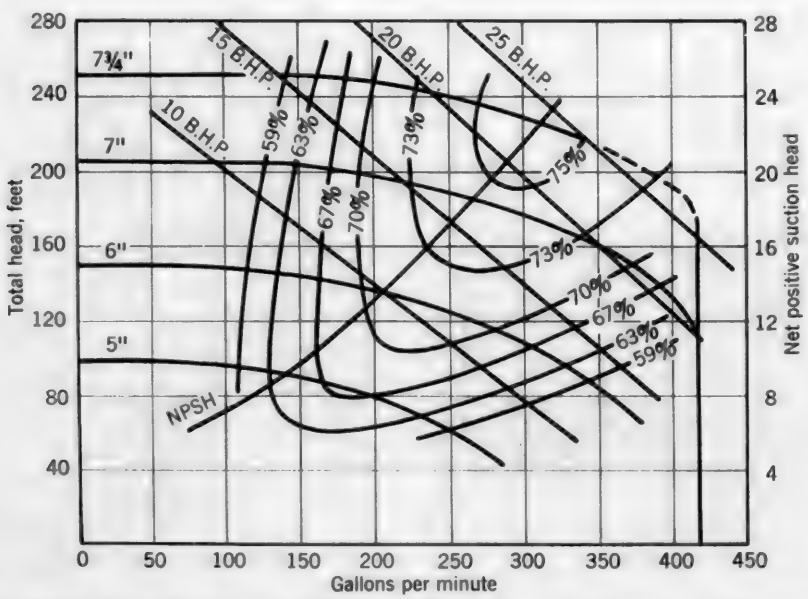

Fig. 4. Pump curves for a given pump with four different impeller diameters. See text and Fig. 5.

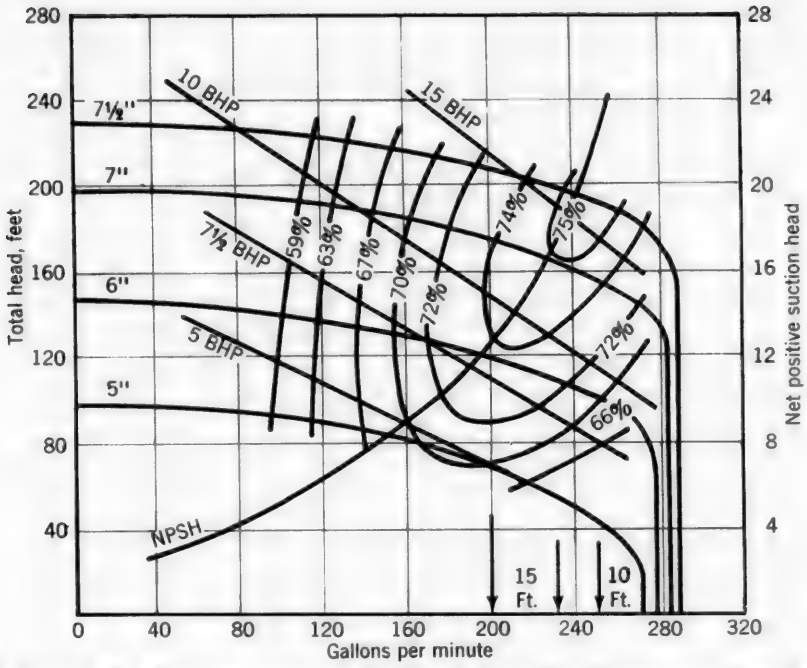

Fig. 5. Curves for the same pump as in Fig. 4 but with different impellers. See text.

tion and discharge conditions and even the characteristics of the fluid can be changed as the pump is switched back and forth. To obtain the desired flexibility and prevent the pump from becoming overloaded, a pump with a non-overloading impeller should be selected.

There are two ways to obtain a non-overloading pump: (1) Specify a non-overloading impeller for the pump; or (2) Specify a motor whose horsepower is equal to or greater than the maximum horsepower required by the pump; this technique, however, is an expensive way to get a non-overloading pump. For example, the pump performance in Fig. 4 with the 7-inch impeller would be non-overloading with a 25 hp motor. For a condition of 170 gpm at 200 ft, selection of the same pump with non-overloading performance, shown in Fig. 5, could dictate a 7¼-inch diameter impeller but a maximum of only 15 brake horsepower, however.

By initially specifying a non-overloading impeller, the pump manufacturer can supply a pump with a much smaller motor so that the entire unit is less expensive initially and less expensive to operate. To be non-overloading, the brake horsepower curve must reach a maximum at a certain capacity and then level off and not increase with increased capacity. Generally, the manufacturer can produce a non-overloading pump by designing an impeller with fewer vanes, with a smaller angle at outlet of the individual vanes (greater wrap to the individual vanes) or with a smaller discharge width. This is not something that can be done after a pump is installed, but must be taken into consideration in the initial design of the unit.

Non-overloading pumps are a form of safety factor. As with other safety factors, don't get carried away by them. All of the previously mentioned changes inflict a rapid deterioration of both the delivery and head generated by a given diameter impeller, as shown in Fig. 6. This will result in the selection of a larger diameter impeller for a given system. The units are often somewhat less efficient and can cost more to operate than a standard impeller.

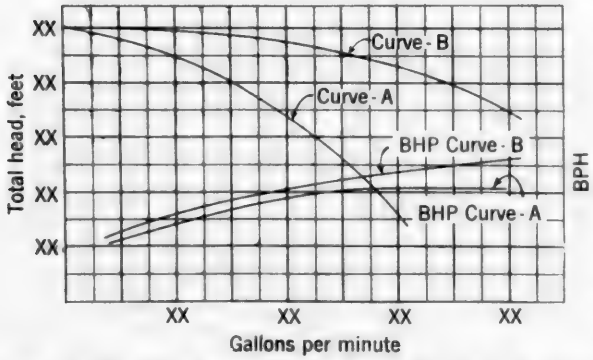

Fig. 6. The impeller represented by Curve A is non-loading as the brake horsepower reaches a maximum and does not increase with increased capacity. Note that on curve B, a standard pump curve, the brake horsepower increases continuously to the maximum capacity of the pump.

High Efficiency or Low NPSH

As was mentioned in the previous article in this series, to match a system with a low NPSH (net positive suction head), it is generally necessary to buy

TABLE I. SPECIFIC GRAVITY AND VISCOSITY OF VARIOUS LIQUIDS

Liquid	Temp [1] deg F	Specific gravity (at Temp 1)	Temp [2] deg F	Kinematic viscosity, centistokes (at Temp 2)	Kinematic viscosity, SSU (at Temp 2)
Automobile crankcase oils					
SAE 10	60	.88-94	130	—	90-120
SAE 20	60	.88-94	130	—	120-185
SAE 30	60	.88-94	130	—	185-225
SAE 40	60	.88-94	130	—	225-400
SAE 50	60	.88-94	210	—	80-105
SAE 60	60	.88-94	210	—	105-125
SAE 70	60	.88-94	210	—	125-150
Beer	60	1.01	68	—	32 (est)
Benzol (benzene)	68	.879	68	.744	—
Brine, calcium chloride, 25%	60	1.23	60	—	39
Brine, sodium chloride, 25%	60	1.19	60	—	34
Refrigerant 11	70	1.49	70	.32	—
Refrigerant 12	70	1.33	70	.21	—
Refrigerant 21	70	1.37	70	.27	—
Fuel oil, No. 1	60	.82-95	100	—	30-40
No. 2	60	.82-95	100	—	35-50
No. 3	60	.82-95	100	—	55 max
No. 5	60	.82-95	100	—	60-450
No. 6	60	.82-95	122	—	430-2900
Gasoline, typical (a)	60	.74	60	.88	—
(b)	60	.72	60	.64	—
(c)	60	.68	60	.46	—
Kerosene	60	.78-.82	68	—	35
Water (fresh)	60	1.0	60	1.1	31.5
Water (sea)	60	1.03	60	—	31.5

a slower speed, larger, more expensive pump. But, sooner or later, someone will offer you an impeller with a low NPSH in a nice neat package operating at 3450 rpm. Will it work? Yes, it is quite possible. However, you will end up paying for this nice neat package every minute the pump is running.

Low required NPSH is obtained (for a given diameter impeller) by opening up the impeller eye to cut down on the inlet velocity, among other things. On a given diameter impeller, opening the eye results in shortening the flow path. As the flow path is shortened, efficiency can drop, the head is often reduced, and the capacity frequently drops off.

Low NPSH and high efficiency are quite often incompatible. It is frequently much less expensive in the long run to alter the system to provide greater available NPSH than to require low NPSH for the impeller. Of course, there are some conditions, such as condensate return, where it is impossible to obtain anything but a low NPSH. Under such conditions the loss in efficiency must be tolerated.

Liquid Characteristics

Most common characteristics of the liquid that exert influence on proper impeller selection are entrained gases or solid particles; viscosity of the liquid; specific gravity and vapor pressure of the liquid. Some of these are of concern to heating and air conditioning engineers while others are of occasional interest.

Viscosity and specific gravity are in the latter category. Although they are important, it is rare that air conditioning engineers would be concerned with viscosities much out of the normal range of 30 to 50 S.S.U. As viscosity goes up, the efficiency, head and capacity of the pump is decreased. Naturally, the pump horsepower goes up. Tables are available from the Hydraulic Institute to show the corrections necessary.

Specific gravity of various liquids encountered by air conditioning engineers may vary considerably. Water, naturally is 1.0; gasoline, kerosene and fuel oils are considerably less than this; while liquids used in refrigeration can be 20 to 30% heavier than water (see Table 1). The horsepower varies directly with the specific gravity of the liquid being pumped. Merely calculate the system using water and make the correction.

Of greater concern is the effect of volatile liquids on the net positive suction head. This subject is so vast that only a word of caution can be given in passing. Refrigerants, gasoline, kerosene, and fuel oils vaporize readily at normal temperatures and pressure. As the temperature of the liquid goes up so does the vapor pressure—lowering the available NPSH considerably and contributing to cavitation, vapor binding and loss of prime.

Next month Mr. Pollak shows how to make up your mind on such matters as mountings, single or double suction, stuffing boxes, mechanical seals.

A Guide to

HOSPITAL PLUMBING

Preliminary Estimates

Cold Water Piping

Hot Water Systems

Sanitary Drainage

Oxygen Systems

Vacuum Systems

Compressed Air Systems

Natural Gas Systems

Floor Drains

Lavatory and Sink Trim

Bibliography

October, 1961

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TABLE I — DATA FOR ESTIMATING WATER REQUIREMENTS

Fixture	Fixture Units		Pipe Sizes, Inches					Remarks
	Water	Waste	Waste	Trap	Vent	Cold Water	Hot Water	
Water Closet (Pvt.)	6	6	4	—	2	1¼	½	
Water Closet (Public)	10	6	4	—	2	1¼	½	H.W. required with bed pan washer hose only
Lavatory	2	1	1½	1½	1½	½	½	
Urinal	10	5	2	—	1½	1	—	
Shower	4	2	3 FD	3	—	½	½	
Patient Bath (Pub.)	4	2	2	2	—	½	½	
Patient Bath (Pvt.)	2	2	2	2	—	½	½	
Drinking Fountain	1	½	1¼	1¼	1¼	½	—	
Sitz Bath	4	2	2	2	—	½	½	
Clinical Sink	10 C.W. 4 H.W.	6	4	—	—	1¼	¾	
Janitor's Sink	3	3	3	3	1½	¾	¾	
Scrub Sink	4	3	2	2	1½	¾	¾	2, 3 or 4 place sink
Single Sink for Misc. Hospital Use	3	2	1½	1½	1½	½	½	
Double Sink for Misc. Hospital Use	4	2	2	2	1½	¾	¾	
Laboratory Sink	2	2	1½	1½	1½	½	½	Use 3-inch waste for island type sink
Ice Machine	1	1	2 FD	2	—	¾	—	
Plaster Sink	4	2	2	2	1½	¾	¾	Use with plaster trap
X-Ray Tank	4	2	1½	1½	1½	½	½	Based on 18 x 30 x 22-inch tank
Bed Pan Sanitizer	10	6	3	3	2	1	—	½-inch STM Connection
Floor Kitchen Sink	4	2	2	2	1½	¾	¾	Use with Food Waste Grinder
Dental Unit	1	1	¾	—	—	½	—	Unit requires gas and compressed air
Autopsy Table	4	2	1½	1½	1½	½	½	
Animal Area Sinks	4	2	2	2	1½	¾	¾	
Hose Station	4	2	3 FD	3	—	½	½	
Cup Sink	1	1	1½	1½	1½	½	—	

THE MOST IMPORTANT PROBLEM for the designer of hospital plumbing systems is that of water supply. The modern hospital with its variety of new equipment requires large volumes of water at pressures which will guarantee uninterrupted service under normal emergencies.

If it is at all possible, potable water should be supplied from two separate sources, each separately fed, to guarantee an ample amount of water in case of failure of the primary supply. If this is not possible, extra storage facilities should be considered at a rate of 20 gal per bed. Where it is necessary to make connections with non-potable water systems, such as for fire protection, backflow preventors should be used.

Preliminary Estimates

In the early stages of design it is important to make estimates as to the amount of water required for operation. A good estimate is that each hospital bed will require 220 gal of water per bed per day with no laundry services or 300 gal per bed per day if a laundry is included. Peak loads usually occur during the hours just before noon. During these hours the demand will probably reach 22 gal of water per bed per hour with no laundry or 30 gal per bed per hour with a laundry. (It should be noted that the minimum demand during night hours is 3 gal per hour.) To get an estimate of the instantaneous demand figure in gallons per minute, use twice the peak hourly demand and divide by 60 minutes. This

TABLE 2 — APPROXIMATE CAPACITY OF PUMPS
For Hydro-Pneumatic Water Supply System

Number of Fixtures	Gpm per Fixture
1-30	0.90
31-75	0.76
76-150	0.63
151-300	0.54
301-600	0.45
601-1000	0.40
over 1000	0.38

TABLE 3 — BRANCH PIPE SIZING GUIDE

Nominal Pipe Size, Inches	Maximum Number of Fixture Units	
	Cold Water*	Hot Water
½	—	5
¾	—	12
1	—	21
1¼	10	37
1½	20	69
2	74	172
2½	109	222
3	544	624
4	1250	1250

* If no flush valves are included in the group of fixtures, use figures indicated for hot water.

TABLE 4—HOT WATER DEMAND, FIXTURES

Type of Fixture	Hot Water Demand, Gph
Lavatories, private	2
Lavatories, semi-private	4
Lavatories, public	8
Bathtubs, semi-private	30
Bathtubs, public	45
Showers, private	10
Showers, semi-private	20
Showers, public	50
Showers, hydro-therapeutic	400
Sinks, janitor's	20
Sinks, hospital	15
Sinks, clinical	10
Sinks, laboratory	5
Sinks, kitchen	20
Sinks, pot	50
Dishwasher, small	85
Dishwasher, medium	200
Dishwasher, large	430
Washer, glass	35
Washer, can	50
Bath, arm	35
Bath, leg	100
Bath, Hubbard	600
Bath, continuous flow	165
Bath, sitz	30
Coffee urns	20
Steam table	11
Bain Marie	20
Warming oven	200

will aid in estimating the size of service necessary as well as the size of the water meter.

Later in design, more careful determinations should be made, using the numbers and types of fixtures. Table 1 is based on a water demand fixture unit of three gallons per minute and should be used with the simultaneous use curves shown in most plumbing codes.

Where it is necessary to use a hydro-pneumatic system for either part or all of the water supply, capacity of pumps may be estimated from Table 2.

Size of tank may be estimated by assuming the tank will hold a 10-min supply and that two-thirds of the tank will be air and one-third will be water. Again, these figures are for estimating only and more careful determinations should be made as the job progresses.

In making piping layouts, careful consideration should be given to flexibility. Piping should be arranged and valved in a manner which does not require shutting down large areas during maintenance periods. The hospital should be broken down into various areas and each area should be valved separately. Branches to groups of fixtures should also be valved separately. Loops are desirable because they allow branches to be fed from two directions. In sizing pipe lines, the fixture unit method should be used to determine quantities of water required. A velocity of 5 feet per second is desirable. Branches to groups of fixtures may be sized from Table 3.

Hot Water System

The design of the hot water system is very important and should be planned carefully. A quick estimate of the amount of hot water required can be had by assuming that one-half of water demand estimated previously will be hot water and one-half cold water.

Once the numbers and types of fixtures can be determined, more accurate calculations can be made using Table 4.

Gallon per hour data that are obtained from Table 4 can be used to determine more accurately the sizes of heaters required. Heaters should be selected to provide a great deal of flexibility, as hot water demands vary greatly during the day. Another reason for flexibility is to guarantee uninterrupted service

TABLE 5 — HOT WATER DATA, HYDRO-THERAPY

Type of Equipment	Number of Procedures per Hour
Showers	4
Immersion tanks	2
Bath, leg	2
Bath, arm	2
Bath, sitz	3

in case of failure of one of the heaters. If instantaneous type water heaters are used, (they should be considered only in very special cases) a gpm figure can be had by doubling the gph figure and dividing by 60 minutes. If storage type heaters are used, the heating coils should be sized so that hourly make-up is possible with one heater out of service. Also, in sizing storage type heaters, a utilization factor of 50% should be used, as all of the fixtures will not be in operation at the same time. Storage capacity should be based on 60% of total peak demand in gallons per hour. Hot water recirculating pumps may be sized by allowing one gpm for each 20 hot-water-supplied fixtures.

Modern hospital laundries, using new equipment, required about five gallons of water per pound of laundry, 60% of which will be hot water. Designs should be based on full operation as this is usually the case on Monday mornings after an accumulation of week-end dirty laundry.

Kitchen load estimates can be based upon a normal of 1.37 gal hot water per person per meal. This includes normal temperature water for general use and high temperature water for sanitizing use. The kitchen will probably be run for two 6-hour periods with 4 hours between.

To determine the amount of hot water for hydro-therapy, first obtain the numbers and sizes of equipment to be used. For sizing hot water heaters, the number of procedures per hour may be obtained from Table 5.

Hot water line sizing is done in the same manner as for cold water. However, hydro-therapy, kitchen and laundry areas should be treated separately and gpm figures for these areas should be added to gpm figures for other fixtures to obtain an overall figure. Supply lines to hydro-therapy tanks should be sized by first obtaining the quantity of water, in gallons, required for filling. Next, estimate the amount of time, in minutes, for filling. Finally, with these figures, and with a velocity of 5 fps, but not more than 8 fps, determine the line sizes. Table 6 indicates the maximum lengths of various hot water lines that may be installed without circulating lines and is based on a volume in the pipe of approximately 2.5 gallons.

TABLE 6—HOT WATER BRANCH LENGTHS
That may Be Installed Without Circulating Lines*

Nominal Branch Pipe Size, Inches	Maximum Length of Run, Feet
½	150
¾	90
1	50
1¼	30
1½	23

* Based on volume of water in branch of approximately 2.5 gal.

TABLE 7 — FLOW IN SEWERS
For Estimating Sanitary Drainage System

Sewer Dia., Inches	Flow, Cu Ft per Sec*
6	0.4
8	0.7
10	1.2
12	1.7
15	2.6
18	3.7
21	4.9
24	6.4
27	8
30	12
36	14

* Based on a mean velocity of 2 fps.

TABLE 8 — DATA FOR SIZING DRAINAGE STACKS*

Diameter of Drain, Inches	Maximum Number of Fixture Units	
	Horizontal Branch	Vertical Stack
2	4	10
2½	6	20
3	10	50
4	60	265
5	160	500
6	350	1200
8	1050	3000
10	1950	4700
12	3300	7200

* For use where local codes do not apply.

Sanitary Drainage

Sizes of sanitary drains can be estimated from information previously determined. This can be done by taking the estimated peak hourly demand of water and dividing by 27,000, giving a value in cubic feet per second. An estimate can be made as to size of sewer required from Table 7, which is based on a mean velocity of 2 fps.

TABLE 9 — DATA FOR SIZING BUILDING DRAIN*

Diameter of Drain, Inches	Slope of Building Drain, Inches per Ft		
	1/8	1/4	1/2
	Maximum Number of Fixture Units		
2	13	21	26
2½	16	24	31
3	20	27	36
4	180	216	250
5	390	480	575
6	700	840	1000
8	1600	1920	2300
10	2900	3500	4200
12	4600	5600	6700

* For use where local codes do not apply.

The first step in the design of the hospital sanitary system is to make piping layouts. Pipe should be run as straight as practicable and with as few offsets as possible. Fixture unit rating should be assigned to each fixture as indicated in Table 1. From these fixture unit ratings, and with the aid of Table 8, it is possible to size horizontal branches and vertical stacks; *however, where local codes are available, they should be used for all waste and vent piping.*

To determine the size of the building drain, total the fixture unit ratings of all the vertical stacks and horizontal branches, not previously added, and apply them to Table 9.

Where local codes are not available, the size and maximum length of vents for soil and waste stacks may be determined from Table 10.

TABLE 10 — DATA FOR SIZING VENT STACKS*

Diameter of Soil or Waste Stack, Inches	Number of Fixture Units	Diameter of Vent, Inches								
		1¼	1½	2	2½	3	4	5	6	8
		Maximum Length of Vent, Feet								
1¼	½	225								
1½	4		300							
1½	6		225							
2	4		175							
2	6		125							
2	8		75							
2½	6		175	300						
2½	10		100	400						
2½	20		60	240						
3	12		80	320						
3	30		35	135	400					
3	50		25	100	300					
4	18			50	150	350				
4	50			30	90	200				
4	120			18	50	130	500			
4	265			18	50	130	500			
5	50				40	100	400			
5	120				25	60	240			
5	350				10	25	100	300		
5	500				10	25	100	300		
6	100					40	160	480		
6	210					20	80	240		
6	550					10	40	120	300	
6	1200					10	40	120	300	
8	175						40	120	300	
8	500						25	75	180	750
8	1000						15	45	110	450
8	2500						10	30	75	310
8	3000						10	30	75	310

* For use where local codes do not apply.

TABLE 11 — DATA FOR SIZING SEWAGE EJECTORS

Total Fixture Units	Inflow to Basin, Gpm
150	80
250	100
370	120
500	140
630	160
775	180
920	200
1070	220
1225	240
1550	280
1900	320
2250	360
2650	400
3000	440
3400	480
3800	520
4250	560
4700	600
5100	640
5600	680
6050	720
6550	760
7050	800

TABLE 12 — DATA FOR SIZING HORIZONTAL STORM DRAINS*

Diameter of Drain, Inches	Slope of Drain, Inches per Foot		
	1/8	1/4	1/2
	Maximum Roof Area That Can Be Drained, Sq Ft		
3	822	1,160	1,644
4	1,880	2,650	3,760
5	3,340	4,720	6,680
6	5,350	7,550	10,700
8	11,500	16,300	23,000
10	20,700	29,200	41,400
12	33,300	47,000	66,600
15	59,500	84,000	119,000

* For use where local codes do not apply.

TABLE 13 — DATA FOR SIZING LEADERS AND CONDUCTORS*

Diameter of Leaders and Conductors, Inches	Maximum Roof Area That Can Be Drained, Sq Ft
2	720
2½	1,300
3	2,200
4	4,600
5	8,650
6	13,500
8	29,000

* For use where local codes do not apply.

In hospitals where drainage by gravity is impossible, basins with sewage ejectors will have to be provided. A duplex arrangement should be provided with each ejector capable of handling the total load into the basin. The basin must be vented and the size should be based on the total flow into the basin. A determination of the size of each ejector can be made from the Table 11, which is based on calculated simultaneous flow of the fixtures.

Storm sewers may be sized in accordance with Tables 12 and 13.

Oxygen Systems

Central oxygen systems must provide a continuous, uninterrupted supply of oxygen to the hospital piping system. This is always accomplished by providing a primary supply as well as an emergency stand-by supply.

Some of the areas requiring oxygen are: patient bedrooms, operating rooms, nurseries, emergency rooms, labor rooms, delivery rooms, recovery rooms and flame photometry rooms.

If the supply is located outside the hospital, the system should be valved where it first enters the building. There should be no other valves between this point and the branch to the operating rooms. Each operating room should be valved separately; with the valve located in the corridor outside the operating room. Patient areas should be valved at the nurses' station controlling the area.

An alarm should be installed to indicate when the primary supply has switched to the emergency stand-by supply. An additional alarm should indicate when the pressure in the system has dropped below 50 psi. Locate alarms at a point where 24-hour surveillance is possible. Normally, the hospital switchboard is the preferred location. Consideration should be given to placing an additional alarm in the superintendent's office. All alarms should be audible as well as visual.

The average rate of flow at each outlet is 8 liters per minute. However, when oxygen tents are first being filled, this rate may go as high as 15 liters per minute. Systems should be designed using 8 liters per minute with a use factor as follows:

TABLE 14 — DATA FOR SIZING OXYGEN SUPPLY PIPING

Oxygen Flow, Liters per Min	Nominal Pipe Size, Inches								
	½	¾	1	1¼	1½	2	2½	3	4
	Pressure Drop per 100 Ft of Pipe, Psi								
50	0.04								
100	0.16								
125	0.25								
150	0.33	0.04							
175	0.48	0.06							
200	0.63	0.07							
250	0.99	0.11							
300	1.41	0.16	0.04						
400	2.51	0.29	0.07						
500	3.92	0.45	0.11						
750		1.02	0.24						
1000		1.80	0.42	0.13	0.05				
1250		2.81	0.66	0.21	0.09				
1500		1.05	0.95	0.30	0.12				
2000				0.67	0.22	0.05			
2500				0.83	0.34	0.08			
3000				1.19	0.49	0.11			
4000				2.11	0.88	0.20	0.06		
5000				3.30	1.36	0.32	0.10		
7500					3.10	0.71	0.22	0.09	
10,000						1.27	0.40	0.16	
15,000						2.82	0.89	0.35	0.08
20,000						5.00	1.58	0.63	0.15
25,000							2.47	0.98	0.23
30,000							3.55	1.40	0.31
40,000								2.48	0.59
50,000								3.90	0.92

Number of Outlets	*Percent Usage*
1- 3	100%
4-12	75%
13-20	50%
21-40	33%
41 or more	25%

The piping system may be sized from Table 14. Total pressure drop to the farthest outlet should be not more than five pounds.

Vacuum Systems

A central vacuum system is desirable in hospitals; first, to provide the surgeon with a means of continuous removal of fluids from an incision during an operation; second, for post-operative drainage in patient areas; and third, in the laboratories for cleaning delicate apparatus and for transferring liquids and gases from one container to another.

Vacuum pumping units, located usually in either the basement or the penthouse, provide an uninterrupted suction pressure of from 15 to 20 inches of mercury. Pumping unit consists of two vacuum producer pumps, each sized to handle the entire (or at least two-thirds) load of the system, a receiver, and necessary controls. Separate pumping units should be used for the hospital clinical and laboratory systems.

When the pumping unit is located in the basement, the horizontal piping from the vacuum drop (the vertical pipe to the room outlet) should pitch downward toward the receiver. When the pumping unit is located in the penthouse, the horizontal branch piping from the vacuum drops should pitch downward toward the vertical riser going to the penthouse, so that any liquids entering the system will flow toward the vertical riser. Each outlet should be placed in a box, recessed into the wall, so that the outlet can be removed and the vertical drop quickly rodded clean.

Cleanouts are very important in the piping system. Each connection should be made with a cross rather than a tee, and a removable cap should be placed at the odd opening. Drip pockets should also be provided at the base of each vertical riser.

TABLE 15 — VACUUM DEMAND IN HOSPITALS

Location of Outlet	Volume per Outlet, Cfm	Percent of Simultaneous Use
Operating room	2.0	100
Laboratory	1.0	40
Pharmacy	1.0	40
Patient room	1.0	20
Recovery room	1.0	100
Labor room	1.0	20
Bronchography	1.0	100
Dental unit	1.0	20
Emergency room	2.0	100
Delivery room	2.0	100
Cystoscopy and Urology	1.0	40
Eye, ear, nose and throat	1.0	20
Decompression	2.0	100
Frozen sections	1.0	20
Suspect nursery	1.0	40
Autopsy room	2.0	100
Treatment and examinating rooms	1.0	20

Table 15 is useful in sizing the pumping units as well as the piping system.

The piping system may be sized from Table 16 by keeping the total pressure drop to the farthest outlet to not more than 5 inches of mercury.

Compressed Air Systems

Compressed air is used primarily in the laboratories and pharmacy. However, the development of new equipment and techniques has expanded its use to areas such as nurseries, delivery rooms, solution rooms, needle rooms, dental rooms, cystoscopy and urology rooms, fluoroscopy rooms, EEG rooms, lecture rooms, incinerator rooms and plumbing shops.

Equipment necessary to produce the 50-psi pressure required consists of a duplex compressor and receiver set, together with the necessary controls. Again, as a means of providing uninterrupted service, two compressors, each designed to carry the entire load should be selected.

Since most of the outlets require only from 5 to 15

TABLE 16 — DATA FOR SIZING VACUUM PIPING

Air Flow, Cfm	Nominal Pipe Size, Inches							
	¾	1	1¼	1½	2	2½	3	4
	Pressure Drop per 100 Ft of Pipe, Inches Hg							
1	.002							
2	.008	.002						
3	.016	.004						
4	.024	.006	.002					
5	.036	.008	.002					
6	.048	.012	.004					
7	.060	.016	.004					
8	.076	.020	.006					
9	.092	.024	.008					
10	.110	.028	.010	.004				
15	.240	.060	.018	.008	.002			
20	.416	.104	.030	.014	.004			
25	.640	.162	.044	.022	.006	.002		
30	.920	.234	.064	.030	.008	.002		
35		.318	.082	.040	.010	.004		
40		.420	.104	.050	.014	.004	.002	
45		.530	.124	.062	.016	.006	.002	
50		.650	.148	.074	.020	.006	.003	
60			.200	.100	.026	.010	.004	
70			.270	.132	.036	.012	.005	.002
80			.350	.176	.050	.016	.006	.002
90			.440	.214	.062	.020	.008	.002
100			.520	.260	.076	.024	.010	.003
125			.780	.380	.110	.034	.014	.004
150				.560	.138	.046	.020	.006
175				.660	.178	.060	.026	.008
200				.840	.224	.076	.032	.008

TABLE 17 — DATA FOR SIZING COMPRESSED AIR PIPING

Air Flow, Cfm	Nominal Pipe Size, Inches							
	½	¾	1	1¼	1½	2	2½	3
	Pressure Drop per 100 Ft of Pipe, Psi							
5	0.81	0.18	0.05					
10	3.23	0.73	0.20	0.05				
15	7.27	1.63	0.45	0.10				
20	1.30	2.90	0.79	0.18	0.08			
25		4.53	1.24	0.29	0.13			
30		6.47	1.79	0.41	0.18			
35		8.69	2.43	0.57	0.25			
40		11.58	3.17	0.74	0.33			
45			4.01	0.93	0.41	0.11		
50			4.92	1.15	0.51	0.14		
60			7.14	1.66	0.73	0.20		
70			9.70	2.25	0.99	0.26	0.10	
80			12.70	2.94	1.30	0.35	0.14	
90				3.73	1.65	0.44	0.17	
100				4.60	2.03	0.55	0.21	
110				5.57	2.46	0.66	0.25	
120				6.63	2.93	0.78	0.30	
130				7.78	3.44	0.92	0.36	0.11
140				9.01	3.99	1.07	0.42	0.13
150				10.36	4.59	1.22	0.47	0.15
160				11.80	5.21	1.40	0.54	0.17
170					5.89	1.60	0.61	0.19
180					6.62	1.77	0.68	0.22
190					7.36	1.96	0.77	0.24
200					8.15	2.18	0.85	0.26

psi pressure, a separate line with a P.R.V. should be used to service these outlets. Outlets requiring higher pressures may be serviced with a separate line from the receiver.

Line sizes should be based on each outlet requiring one cubic foot per minute of air. Hospital outlets should be sized with a 100% utilization factor and laboratories and pharmacy outlets should have a utilization factor of 50%. Table 17 can serve as a ready means of sizing the piping sistem by limiting the pressure drop in the system to 5 psi.

Natural Gas Systems

Low pressure natural gas is supplied to hospitals for use in laboratories, kitchens, incinerator rooms and flame photometry rooms. The pressure at the meter is usually 0.6 inches of water column and the system should be designed for a delivery of 0.4 inches w.c. at the fixtures.

Great care should be taken in the design of the piping system. Pipes should always be pitched, with a dirt pocket provided at each low point. Vertical risers should also have dirt pockets at their bases. Access panels should be placed for easy cleaning of the dirt pockets. Pipes should never be run in concealed locations where leaks will not be noticed, nor should they ever be run underground unless they are placed inside a vented duct. Pipes should not be run in air handling ducts.

Laboratory areas should be valved separately to facilitate shutdowns. The branch to the flame photometer should contain a double check valve to prevent oxygen from entering the gas system.

In sizing the gas system, it is necessary to obtain gas requirements for the kitchen and incinerator from the manufacturers of the equipment to be used Laboratory outlets should be sized on the basis of 7 cfh per burner with a utilization factor of 50%. The piping system may be sized from Table 18 by keep the total pressure drop in the system to 0.2 inches w.c.

Floor Drains

The designer should give very careful consideration in determining which areas should be protected with floor drains. Flushing rim type floor drains should be used in morgue, autopsy, animal, urology and cystoscopy rooms. Flushing is accomplished

TABLE 18 — DATA FOR SIZING NATURAL GAS PIPING

Gas Flow, Cfh	Nominal Pipe Size, Inches							
	½	¾	1	1¼	1½	2	3	4
	Pressure Drop per 100 Ft of Pipe, Inches w.c.							
5	.01							
10	.04							
15	.08	.01						
20	.15	.02						
25	.23	.03						
30	.33	.04	.01					
40	.59	.07	.02					
50	.94	.12	.03	.01				
75		.25	.06	.02				
100		.45	.11	.03	.01			
125		.69	.17	.05	.02			
150		1.10	.24	.08	.03			
175			.33	.11	.04	.01		
200			.44	.14	.05	.01		
250			.68	.21	.08	.02		
300			.99	.31	.13	.03		
350				.42	.17	.04		
400				.55	.22	.05		
500				.87	.34	.08	.01	
750					.78	.19	.02	
1000						.34	.04	.01
1250						.53	.07	.02
1500						.79	.09	.02
2000							.17	.04
3000							.40	.09

through a remotely located flush valve, the water supply for which should be protected with a vacuum breaker. The following list is an indication as to what type of floor drain may be used in the various rooms in the hospital. However, the writer does not mean to indicate that each of the following rooms should have a floor drain; only that if the designer feels one is necessary, he should consider the one which is indicated. The final determination should be based on the size of the room, its intended use and maintenance of the trap seal. Floor drains in out-of-the-way locations where trap seal maintenance is difficult should be equipped with an acceptable resealing device. Where membraned floors are required, clamping flanges should be provided.

1. *Toilet Room—Ground Floor:* Cast iron floor drain with double drainage flange, 6-inch diameter white metal adjustable strainer, 4-inch outlet.
2. *Toilet Room—Above Ground Floor:* Cast iron floor drain with double drainage flange, 6-inch diameter white metal adjustable strainer, 2-inch outlet.
3. *Toilet Room—Psychiatric:* Cast iron floor drain with double drainage flange, 6-inch diameter white metal adjustable strainer with grate secured by vandal proof screws, 3-inch outlet.
4. *Janitor's Closet:* Cast iron non-clog triple drainage floor drain with double drainage flange, white metal 9-inch round top and grate, round perforated sediment bucket with integral auxiliary drainage rim, 4-inch outlet.
5. *Utility Room:* Cast iron floor drain with double drainage flange, 6-inch diameter white metal adjustable strainer, 2-inch outlet.
6. *Shower Stalls:* Cast iron floor drain with double drainage flange, flashing clamps, adjustable white metal non-clog strainer with sediment bucket, 2-inch outlet.

7. *Floor Kitchen:* Cast iron floor drain with double drainage flange, 6-inch diameter white metal adjustable strainer, 3-inch outlet.

8. *Sub-Sterile Area:* Cast iron floor drain with double drainage flange, 6-inch diameter white metal adjustable strainer, 3-inch outlet.

9. *Plaster Room:* Cast iron non-clog triple drainage floor drain with double drainage flange, white metal 9-inch round top and grate, round perforated sediment bucket with integral auxiliary drainage rim, 3-inch outlet.

10. *Urology and Cystoscopy:* Cast iron floor drain with porcelain enameled interior, double drainage flange, flashing clamp, white metal flushing rim top and loose set wide bar grate, 4-inch outlet.

11. *Pharmacy:* Cast iron floor drain with double drainage flange, 6-inch diameter acid resisting adjustable top, 3-inch outlet.

12. *Manufacturing:* Cast iron floor drain with double drainage flange, 6-inch diameter white metal adjustable top, 3-inch outlet.

13. *Bulk and Alcohol Storage:* Cast iron floor drain with double drainage flange, 6-inch diameter white metal adjustable top, 3-inch outlet.

14. *Laboratories:* Cast iron floor drain with double drainage flange, 6-inch diameter acid resisting adjustable top, 3-inch outlet.

15. *Hydrotherapy:* Cast iron "Super-Flo" floor drain with double drainage flange, weepholes, white metal 7-inch round top and anti-tilting grade, 4-inch outlet.

16. *Animal Area:* Cast iron floor drain with porcelain enameled interior, double drainage flange, flashing clamp, white metal flushing rim top and loose set wide bar grate, 4-inch outlet.

17. *Washing and Sterilizing:* Cast iron floor drain with double drainage flange, 6-inch diameter white metal adjustable top, 3-outlet.

18. *Photographic Laboratory and Dark Room:* Cast iron floor drain with double drainage flange, 6-inch diameter white metal adjustable strainer, 3-inch outlet.

19. *Plumbing Shop:* Cast iron non-clog triple drainage floor drain with a double drainage flange, 9-inch round cast iron top and grate, round perforated sediment bucket with integral auxiliary drainage rim, 4-inch outlet.

20. *Paint Shop:* Cast iron extra deep volatile liquids intercepting floor drain with anchor flange, auxiliary vent connection, removable solid sediment bucket, funnel shaped integral seal with integral recessed rim fitted with heavy duty grate, integral deep "P" trap and flush floor cleanout, 4-inch outlet.

21. *Morgue and Autopsy Room:* Cast iron floor drain with porcelain enameled interior, double drainage flange, flashing clamp, white metal flushing rim top and loose set wide bar grate, 4-inch outlet.

22. *Rubbish and Incinerator Room:* Cast iron non-clog triple drainage floor drain with double drainage flanfe, 9-inch round cast iron top and grate, round perforated sediment bucket with integral auxiliary drainage rim, 4-inch outlet.

23. *Soiled Linen Room:* Cast iron non-clog triple drainage floor drain with double drainage flange 9-inch round brass top and grate, round perforated sediment bucket with integral auxiliary drainage rim, 4-inch outlet.

24. *Elevator and Dumbwaiter Pits:* Cast iron end type drain with vertical grate, anchor flange, 4-inch side outlet.

25. *Mechanical Equipment Room—General:* Cast iron floor drain with double drainage flange, weepholes, bottom outlet, round top and deep set tractor grade, 4-inch outlet.

26. *Mechanical Equipment Room—Special Waste Sink:* Cast iron drain with round top having stirrups for drain lines at surface, drain sump with recessed flat grate, 4-inch outlet.

27. *Kitchen—General:* Cast iron non-clog triple drainage floor drain with with double drainage flange, white metal 9-inch round top and grate, round perforated sediment bucket with integral auxiliary drainage rim, 3-inch outlet.

28. *Kitchen—At Kettles:* Cast iron non-clog triple drainage floor drain with double drainage flange, white metal round top and grate, round perforated sediment bucket with integral auxiliary drainage rim, 4-inch outlet. The drainage from these floor drains should be connected to a grease interceptor.

29. *Kitchen — Potato Peeler:* Cast iron drain with double drainage flange, 12-inch x 12-inch square top, sediment bucket, 3-inch outlet.

30. *Kitchen — Refrigeration Machine Room:* Cast iron drain with round top having stirrups for drain lines at surface, drain sump with recessed flat grate, 4-inch outlet.

31. *Tunnels:* Cast iron floor drain with double drainage flange, round top, deep set tractor grate, 4-inch caulk outlet.

32. *Areaway:* Cast iron area drain with double drainage flange, weepholes, round top, bottom outlet, round dome loose set grate, 4-inch caulk outlet.

33. *Laundry — General:* Cast iron non-clog triple drainage floor drain with double drainage flange, white metal 9-inch round top and grate, round perforated sediment bucket with integral auxiliary drainage rim, 4-inch outlet.

34. *Laundry — Trenches:* Cast iron torrential type drain with deep sump, large flange, large dome, sediment stop, 6-inch caulk outlet.

35. *Drain for Glove Washer, Syringe Washer and Photography Print Washer:* Cast iron floor drain with double drainage flange, weepholes, 7-inch polished brass adjustable funnel strainer, 3-inch outlet.

36. *Locker Room:* Cast iron floor drain, with double drainage flange, 6-inch diameter white metal adjustable strainer, 3-inch outlet.

37. *Sterilizer Recess Room:* Cast iron floor drain with double drainage flange. Weepholes, 7-inch cast iron adjustable funnel strainer, 3-inch outlet.

Lavatory and Sink Trim

Modern hospitals require a very large variety of lavatories and sinks to do the many jobs necessary for its operation. Special considerations should be given to the selection of the trim for these sinks and lavatories. Selection should be based on maintaining sanitary conditions as well as the various techniques which will be employed. In accordance with the latest thinking, blade handles for wrist action should be at least 6 inches long. This will guarantee more sanitary conditions. The writer has deliberately avoided the use of elbow action as he feels more satisfactory results can be had with either wrist or foot action. Pop-up type wastes should also be avoided, except in employee areas, as they do nothing more than create unsanitary conditions. All spouts should be anti-hose unless provided with a suitable vacuum-breaking device.

Table 19 may be used as a guide in determining what type of spout and action to use.

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TABLE 19 — GUIDE TO SELECTION OF SPOUTS AND ACTIONS FOR HOSPITAL LAVATORIES AND SINKS

Location	Type of Spout	Type of Action
NURSING DEPARTMENT		
Patient Toilet Room	Gooseneck	Wrist
Patient Toilet Room—Isolation	Gooseneck	Knee
Utility Room	Gooseneck	Wrist
Treatment Room	Gooseneck	Wrist
Medicine Room	Gooseneck	Wrist
Lavatory in Floor Kitchen	Gooseneck	Foot
Sink in Floor Kitchen	Sink Faucet	Wrist
Nurses Toilet Room	Lavatory Supply	Hand
Floor Laboratory	Laboratory Gooseneck	Vertical Hand
NURSERY		
Nursery	Gooseneck	Foot
Suspect Nursery	Gooseneck	Foot
Examination and Treatment	Gooseneck	Foot
Premature Nursery	Gooseneck	Foot
Formula Room	Gooseneck	Foot
Labor Room	Gooseneck	Foot
SURGICAL		
Scrub Room	Gooseneck with Spray Head	Knee
Sub-sterile Room	Sink Faucet	Wrist
Clean Up Room	Sink Faucet	Wrist
Frozen Sections Room	Laboratory Gooseneck	Vertical Hand
Surgical Supply Room	Gooseneck	Wrist
Work Room	Sink Faucet	Wrist
Cystoscopic Room	Gooseneck with Spray Head	Knee
Fracture Room	Sink Faucet	Wrist
Recovery Room	Gooseneck	Foot
CENTRAL SUPPLY		
Work Room	Sink Faucet	Wrist
Solutions Room	Sink Faucet	Wrist
Needle & Syringe Room	Sink Faucet	Wrist
Glove Room	Gooseneck	Wrist
Pharmacy	Laboratory Gooseneck	Vertical Hand
Manufacturing	Gooseneck	Wrist
EMERGENCY DEPARTMENT		
Observation Bedroom	Gooseneck	Foot
Utility Room	Gooseneck	Foot
Operating Room	Gooseneck with Spray Head	Knee
D.O.A. Room	Gooseneck	Wrist
Examination Room	Gooseneck	Foot
DIAGNOSTIC AND TREATMENT		
Occupational Therapy	Gooseneck	Wrist
Hydro-therapy Room	Gooseneck	Wrist
Examination Room	Gooseneck	Foot
Deep Therapy	Gooseneck	Wrist
Superficial Therapy	Gooseneck	Wrist
Radium Treatment & Exam.	Gooseneck	Foot
Toilet Room	Gooseneck	Wrist
Dark Room	Sink Faucet	Hand
Autopsy	Gooseneck with Spray Head	Knee
Lavatory in Autopsy Shower Room	Gooseneck	Wrist
Laboratories	Laboratory Gooseneck	Vertical Hand
OUTPATIENT DEPARTMENT		
Examination & Treatment Room	Gooseneck	Foot
Dental Operating	Gooseneck	Knee
Dental Laboratory	Laboratory Gooseneck	Vertical Hand
Dental Recovery	Gooseneck	Knee
Surgical Room	Gooseneck with Spray Head	Knee
Eye Examination Room	Gooseneck	Knee
Ear, Nose & Throat Room	Gooseneck	Knee
SERVICE DEPARTMENT		
Lavatory in Kitchen	Lavatory Supply	Foot

About the Author

Lawrence Guss, a lifelong resident of Detroit, received his BSME from Lawrence Institute of Technology in 1949. He has served in the U.S. Army at Picatinny Arsenal, Dover, N. J., where he worked on the atomic cannon. Employed by the Department of Water Supply, City of Detroit, for seven years, for the last five years he has been with Smith, Hinchman & Grylls Associates, Inc., architects and engineers, in mechanical design. Mr. Guss is co-chairman of the Research Committee of the Michigan chapter of the American Society of Sanitary Engineering and a member of the national organization's Hospital Plumbing Standards Committee.

Note on Appendices A and B

The following data, on hospital fixture and equipment backflow preventive devices and on plumbing fixture ratings, are presented in the hope that they will stimulate discussion in the sanitary engineering profession. The data are based on the author's experience in hospital plumbing design. However, it is recognized that the common judgment of the largest number of researchers and designers, based on their combined experiences, could result in amended and improved tabulations that would be of widespread value to the profession. Comments and suggestions, addressed to The Editor, are welcomed and will be forwarded to the author.

—The Editor

Appendix A. Proposed Hospital Plumbing Fixture Ratings

Fixture	Fixture Units			GPM		GPH
	Total, Water	Cold Water	Hot Water	Cold Water	Hot Water	Hot Water
GENERAL AREAS						
Aspirator, fluid suction	2	2	—	3	—	—
Aspirator, laboratory	2	2	—	3	—	—
Autopsy table, complete	4	3	2	8	4½	20
Autopsy table, aspirator	2	2	—	3	—	—
Autopsy table, flushing hose	2	2	—	3	—	—
Autopsy table, flushing rim	3	3	—	4½	—	—
Autopsy table, sink and faucet	3	2½	2½	4½	4½	20
Autopsy table, waste disposal	1½	1½	—	4	—	—
Bath, arm	4	2	3	3	7	35
Bath, emergency	4	2	3	3	7	15
Bath, immersion	20	7	15	15	35	450
Bath, leg	10	4	7	8	16	100
Bath, sitz	4	2	3	3	7	30
Bathtub, general	4	2	3	3	7	45
Bathtub, private	2	1½	1½	3	7	15
Bed pan, washer, steam	10	10	—	25	—	—
Bidet	4	3	3	4½	4½	15
Cleaner, sonic	3	2½	2½	4½	4½	20
Cuspidor, dental and surgical	1	1	—	2	—	—
Cuspidor, dental chair	1	1	—	2	—	—
Drinking fountain	1	1	—	2	—	—
Floor drain, flushing type	10	10	—	25	—	—
Hose, bed pan general	2	1½	1½	3	3	5
Hose, bed pan private	1	1	1	3	3	2
Laundry tub	3	2½	2½	4½	4½	30
Lavatory, barber	2	1½	1½	3	3	15
Lavatory, dental	1	1	1	3	3	8
Lavatory, general	2	1½	1½	3	3	8
Lavatory, private	1	1	1	3	3	4
Lavatory, nursery	2	1½	1½	3	3	8
Lavatory, scrub-up	2	1½	1½	3	3	10
Lavatory, treatment	1	1	1	3	3	4
Microscope, electron	1	1	—	0.2	—	—
Sanistan	10	10	—	25	—	—
Sanitizer, boiling, instrument	2	—	2	—	3	10
Sanitizer, boiling, utensil	2	—	2	—	3	10
Shower, general	4	2	3	1½	3½	50
Shower, private	2	1	2	1½	3½	20
Shower, obstetrical	4	2	3	1½	3½	50
Shower, therapeutic	15	6	11	15	35	400
Sink, barium	3	2½	2½	4½	4½	15
Sink, clean-up room	3	2½	2½	4½	4½	15
Sink, central supply	3	2½	2½	4½	4½	15
Sink, clinical	10	10	3	25	3	10
Sink, clinical, bed pan hose	10	10	4	25	4½	15
Sink, floor kitchen	4	3	3	4½	4½	20
Sink, formula room	4	3	3	4½	4½	20
Sink, cup	1	1	—	3	—	—
Sink, laboratory	2	1½	1½	3	3	5
Sink, laboratory and trough	3	2½	1½	5	3	5
Sink, pharmacy	2	1½	1½	3	3	5
Sink, plaster	4	3	3	4½	4½	15
Sink, private kitchen	3	2½	2½	4½	4½	15

GENERAL AREAS

Sink, misc. general purpose	3	2½	2½	4½	4½	10
Sink, nurses station	2	1½	1½	3	3	5
Sink, scrub-up	4	3	3	4½	4½	50
Sink, sub-ster. room	3	2½	2½	4½	4½	15
Sink, clean utility	3	2½	2½	4½	4½	15
Sink, soiled utility	3	2½	2½	4½	4½	20
Sterilizer, autoclave	2-6	2-6	—	3-10	—	—
Sterilizer, boiling, instrument	2	—	2	—	3	10
Sterilizer, boiling, utensil	2	—	2	—	3	10
Sterilizer, pressure instrument	2	2	—	3	—	—
Washer-sterilizer	6	6	—	10	—	—
Sterilizer, water	5	5	2	3	4½	15
Urinal, pedestal, flush valve	10	10	—	15	—	—
Urinal, stall, flush valve	5	5	—	6	—	—
Urinal, wall, flush valve	5	5	—	15	—	—
Urinal, tank	3	3	—	1	—	—
Washer, flask	4	—	4	—	4½	10
Washer, formula bottle	4	4	—	5	—	—
Washer, glove	4	3	3	4½	4½	20
Washer, glassware	4-6	—	4-6	—	5-10	25-180
Washer, needle	2	2	—	3	—	—
Washer, pipette	4	3	3	4½	4½	15
Washer, syringe	4	—	4	—	5	10
Washer, tube	4	4	—	5	—	—
Washer, sterilizer, utensil	2	1½	1½	3	3	10
Water closet, flush valve, general	10	10	—	25	—	—
Water closet, flush valve, private	6	6	—	25	—	—
Water closet, tank, general	5	5	—	3	—	—
Water closet, tank, private	3	3	—	3	—	—

KITCHEN AREA

Bains Marie	2	2	—	3	—	—
Coffee urn	2	2	—	3	—	—
Grinder, food waste	3	3	—	8	—	—
Hose, pre-rinse	3	2½	2½	4	4	45
Lavatory	2	1½	1½	3	3	10
Peeler, vegetable	3	3	—	4½	—	—
Sink, bar type	3	2½	2½	4	4	30
Sink, dish soak	3	2½	2½	4	4	30
Sink, pot and pan (per faucet)	4	3	3	4½	4½	30
Sink, vegetable	3	2½	2½	4	4	45
Soup, kettle	2	1½	1½	3	3	60
Steam table	2	2	—	3	—	—
Washer, can	10	10	10	15	15	50
Washer, glassware	2	1½	1½	3	3	15
Washer, pot and pan	3	—	3	—	10	75
Washer, silver	2	—	2	—	4½	45

SPECIAL AREAS

Condenser, drinking fountain	1	1	—	1	—	—
Condenser, refrigeration	1	1	—	1	—	—
Condenser, sterilizer	2-6	2-6	—	3-10	—	—
Cooling coil, water sterilizer	5	2	—	3	—	—
Cooling tower make-up	—	—	—	.1/Ton	—	—
Fire sprinklers	10	10	—	20	—	—
Ice cuber and flaker	1	1	—	1	—	—
Hose connection, interior	4	4	—	5	—	—
Hose connection, sill cock	4	4	—	5	—	—
Hose connection and hot water supply	4	3	3	4½	4½	15
Pump, air compressor	1-8	1-8	—	½-12	—	—
Pump, vacuum	1-8	1-8	—	½-12	—	—
Still	1-6	1-6	—	½-10	—	—

Appendix B — Examples of Hospital Fixture and Equipment Backflow Preventive Devices for Water Supply Protection

The writer realizes that the subject of backflow preventive devices is controversial, and that existing codes vary a great deal in their treatment of the subject. The attempt here is to bring to the attention of the designer the fact that the following equipment should have a device which will protect the potable water supply. In all cases the local codes must prevail. However, where codes are not available the following information will be useful.

Equipment	Protective Device	Location	Note No.
Bath with shampoo nozzle	Vacuum breaker	6'-0" above bottom of tub	1
Bed pan sanitizer	Vacuum breaker	Part of flush valve	1
Bed pan washer hose	Vacuum breaker	5'-9" above floor	1
Hose and faucet at service sink	Vacuum breaker	Part of faucet	3
Sterilizer condenser	Vacuum breaker	4" above unit	1
Flash washer	Vacuum breaker	4" above unit	1
Glove washer	Vacuum breaker	4" above unit	1
Stills	Air gap	On discharge	6
Ultrasonic cleaner	Vacuum breaker	4" above unit	1
Developing tank	Vacuum breaker	4" above unit	1
Rental unit	Vacuum breaker	Part of unit	1
Hydrotherapy bath	Vacuum breaker	4" above unit	1
Radiology cooling coil (water bath)	Air gap	On discharge	6
Pipette washer	Vacuum breaker	4" above unit	1
Glasswasher	Vacuum breaker	4" above unit	1
Laboratory spout	Vacuum breaker	At threaded discharge	2
Cage washer	Vacuum breaker	4" above unit	1
Tube washer	Vacuum breaker	Part of control valve	1
Bottle washer	Vacuum breaker	4" above unit	1
Food waste grinder	Vacuum breaker	4" above unit	1
Peeler	Air gap	On supply	5
Dishwasher	Vacuum breaker	4" above unit	1
Can washer	Vacuum breaker	4" above unit	1
Ice machine	Air gap	On discharge	6
Pot washer	Vacuum breaker	4" above unit	1
Coffee urn	Vacuum breaker	4" above unit	1
Glass washer	Vacuum breaker	4" above unit	1
Refrigeration condenser	Air gap	On discharge	6
Clothes washer	Vacuum breaker	4" above unit	1
Soap and brine tanks	Vacuum breaker	4" above unit	1
Autopsy table	Vacuum breaker	6'0" above floor	1
Aspirator	Vacuum breaker	6'0" above floor	1
Hose station	Vacuum breaker	At threaded discharge	2
Flush rim floor drain	Vacuum breaker	5'-9" above floor	1
Incinerator gas washer	Air gap	On water supply	6
Lawn sprinklers	Vacuum breaker	Outdoor type	1
Wall hydrant	Vacuum breaker	At threaded discharge	2
Hose bibb	Vacuum breaker	At threaded discharge	2
Package air conditioner	Air gap	On discharge	6
Cooling tower	Backflow preventer	On water supply	4
Boiler make-up water	Backflow preventer	On water supply	4
Vacuum pumps and air washing	Air gap	On water supply	5
Spray coil for air washing	Vacuum breaker	4" above unit	1
Expansion tank	Backflow preventer	On water supply	4

Note 1: The designation "vacuum breaker" means a non-pressure, atmospheric type device. The installation elevation means the distance above the spill level of the fixture or equipment served, or the height to which a connected discharge may be raised to cause gravity backflow to reach the device. The designated installation should be measured from the bottom of the device, or the critical level marking if indicated by a stamping valve. The installation and elevation should permit the vacuum breaker to drain and actuate each time the control valve is operated. No shut-off valve should be permitted down-stream from the vacuum breaker. The vacuum breaker should not be installed in a manner so as to be under continuous pressure.

Note 2: The location "at the threaded discharge" means the location where an aerator would normally be installed. The vacuum breaker is the in-line type and for the laboratory faucet the serrated nozzle is then screwed into the discharge end of the vacuum breaker. When this vacuum breaker is used with a hose bibb, it is threaded onto the male end and the hose is connected to the vacuum breaker.

Note 3: The designation "part of the faucet" means that the vacuum breaker is assembled with the faucet to appear as if it were cast integrally with the faucet. This type of faucet is usually furnished with a pail hook and wall braces.

Note 4: The designation "backflow preventer" means the reduced pressure type backflow preventer which includes two spring loaded check valves, a broken connection to a drain and usually two gate valves. The use of this device requires that adequate and rapid drainage be available.

Note 5: An air gap on the water supply means that the air gap shall be located at the supply opening to the fixture or equipment it serves. An air gap is the minimum vertica distance between the supply discharge orifice and the spill level of the receptor, fixture or equipment served. This minimum vertical distance should be at least two diameters of the discharge orifice, or a minimum of one inch, whichever is the greatest.

Note 6: An air gap on the waste line means an indirect connection between the fixture or equipment and the waste receptor. The waste discharge orifice governs the minimum distance according to note No. 5.

FACTOR OF EVAPORATION

The factor of evaporation is used to adjust rated boiler output (from and at 212 deg F) to actual job or operating conditions. Available feedwater temperature and expected boiler operating pressure (psig) affect the boiler output ratings which are based on "from and at 212 deg F."

Example: A calculated load requires 2,980,000 Btu per hr. The boiler must operate at 10 psig and the average feedwater temperature will be 100 deg. What should the boiler rating be?

From the chart below, at 100 deg and 10 psig, we obtain the factor 1.12. This factor is used to convert to the standard rating basis: 2,980,000 Btu per hr × 1.12 = 3,350,000 Btu hr. (Since 33,500 Btu per hr equals one boiler horsepower, 3,350,000 Btu per hr equals a 100 hp rated boiler.)

Thus, a boiler rated at 3,350,000 Btu per hr should be selected in order to provide 2,980,000 Btu per hr to the load. This is due to the effect of feedwater temperature and operating pressure on *rated* boiler output (from and at 212 deg).

Feedwater Temp, Deg F	Gage Pressure, Psig														
	5	10	20	50	70	90	100	110	130	150	170	190	200	225	250
	Factor of Evaporation														
32	1.19	1.19	1.20	1.214	1.219	1.223	1.225	1.226	1.229	1.231	1.233	1.235	1.236	1.237	1.239
40	1.18	1.18	1.19	1.206	1.211	1.215	1.217	1.218	1.221	1.223	1.225	1.227	1.227	1.229	1.231
50	1.17	1.17	1.18	1.196	1.201	1.205	1.206	1.208	1.211	1.213	1.215	1.216	1.217	1.219	1.220
60	1.16	1.16	1.17	1.185	1.190	1.194	1.196	1.198	1.200	1.202	1.204	1.206	1.207	1.209	1.210
70	1.15	1.15	1.16	1.175	1.180	1.184	1.186	1.187	1.190	1.192	1.194	1.196	1.196	1.198	1.200
80	1.14	1.14	1.15	1.162	1.170	1.174	1.176	1.177	1.180	1.182	1.184	1.185	1.186	1.188	1.189
90	1.13	1.13	1.14	1.154	1.160	1.164	1.165	1.167	1.170	1.172	1.173	1.175	1.176	1.178	1.179
100	1.12	1.12	1.13	1.144	1.149	1.153	1.155	1.156	1.159	1.161	1.163	1.165	1.166	1.167	1.169
110	1.11	1.11	1.12	1.134	1.139	1.143	1.145	1.146	1.149	1.151	1.153	1.155	1.156	1.157	1.159
120	1.10	1.10	1.11	1.124	1.129	1.133	1.134	1.136	1.139	1.141	1.143	1.144	1.145	1.147	1.148
130	1.09	1.09	1.10	1.113	1.118	1.123	1.124	1.126	1.128	1.130	1.132	1.134	1.135	1.137	1.138
140	1.08	1.08	1.09	1.103	1.108	1.112	1.114	1.115	1.118	1.120	1.122	1.124	1.125	1.126	1.128
150	1.07	1.07	1.08	1.093	1.098	1.102	1.104	1.105	1.108	1.110	1.112	1.114	1.114	1.116	1.118
160	1.06	1.06	1.07	1.082	1.088	1.092	1.093	1.095	1.097	1.100	1.102	1.103	1.104	1.106	1.107
170	1.05	1.05	1.06	1.072	1.077	1.081	1.083	1.084	1.087	1.089	1.091	1.093	1.094	1.095	1.097
180	1.04	1.04	1.05	1.062	1.067	1.071	1.073	1.074	1.077	1.079	1.081	1.083	1.083	1.085	1.087
190	1.03	1.03	1.04	1.052	1.057	1.061	1.062	1.064	1.066	1.069	1.071	1.072	1.073	1.075	1.076
200	1.02	1.02	1.03	1.041	1.047	1.050	1.052	1.053	1.056	1.058	1.060	1.062	1.063	1.064	1.066
210	1.01	1.01	1.02	1.031	1.036	1.040	1.042	1.043	1.046	1.048	1.050	1.052	1.052	1.054	1.056

POUNDS STEAM PER BOILER HORSEPOWER

The table below, as well as the one on the front of this data sheet, was prepared by Cleaver-Brooks Company as an aid in selecting packaged boilers. It enables one to find the proper boiler rating, given a required output.

Example: A boiler is to have an output of 3060 pounds of steam per hour when operating at 10 psig with feed water at 100 deg F. What should the boiler rating be on the basis of from and at 212 deg?

From the chart below, at 100 deg and 10 psig, we obtain the factor 30.6 pounds of steam per BHp. This factor is used to convert to the "from and at 212 degrees F" rating basis: 3060 ÷ 30.6 = 100. A 100-BHp boiler should be selected.

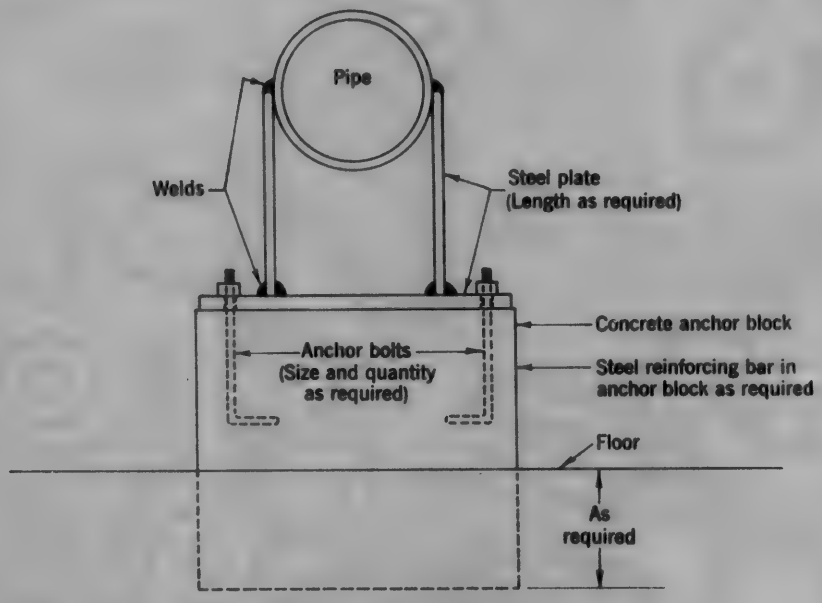
Feedwater Temp, Deg F	Gage Pressure, Psig																	
	0	2	10	15	20	40	50	60	80	100	120	140	150	160	180	200	220	240
	Pounds Dry Saturated Steam per Boiler Horsepower																	
30	29.0	29.0	28.8	28.7	28.6	28.4	28.3	28.2	28.2	28.1	28.0	28.0	27.9	27.9	27.9	27.9	27.9	27.8
40	29.3	29.2	29.1	29.0	28.9	28.7	28.6	28.5	28.4	28.3	28.2	28.2	28.2	28.2	28.2	28.1	28.1	28.1
50	29.6	29.5	29.3	29.2	29.1	28.9	28.8	28.8	28.7	28.6	28.5	28.5	28.4	28.4	28.4	28.3	28.3	28.3
60	29.8	29.8	29.6	29.5	29.4	29.2	29.1	29.0	28.9	28.8	28.8	28.7	28.7	28.6	28.6	28.6	28.6	28.5
70	30.1	30.0	29.9	29.8	29.7	29.5	29.4	29.3	29.2	29.1	29.0	29.0	28.9	28.9	28.9	28.8	28.8	28.8
80	30.4	30.3	30.1	30.0	30.0	29.8	29.6	29.6	29.5	29.3	29.2	29.2	29.2	29.2	29.1	29.1	29.1	29.0
90	30.6	30.6	30.4	30.3	30.2	30.0	29.9	29.8	29.7	29.6	29.5	29.5	29.4	29.4	29.4	29.3	29.3	29.3
100	30.9	30.8	30.6	30.6	30.5	30.3	30.2	30.1	30.0	29.8	29.8	29.8	29.7	29.7	29.7	29.6	29.6	29.6
110	31.2	31.2	30.9	30.8	30.8	30.6	30.4	30.3	30.2	30.0	30.0	30.0	30.0	30.0	29.9	29.9	29.8	29.8
120	31.5	31.4	31.2	31.2	31.1	30.8	30.7	30.6	30.5	30.4	30.3	30.3	30.2	30.2	30.2	30.1	30.1	30.1
130	31.8	31.7	31.5	31.4	31.4	31.1	31.0	30.9	30.8	30.7	30.6	30.6	30.5	30.5	30.4	30.4	30.4	30.4
140	32.1	32.0	31.8	31.7	31.6	31.4	31.3	31.2	31.1	31.0	30.9	30.8	30.8	30.8	30.8	30.7	30.7	30.6
150	32.4	32.4	32.1	32.0	31.9	31.7	31.6	31.5	31.4	31.2	31.2	31.2	31.1	31.1	31.0	31.0	30.9	30.9
160	32.7	32.7	32.4	32.4	32.3	32.0	31.9	31.8	31.7	31.5	31.4	31.4	31.4	31.4	31.3	31.3	31.2	31.2
170	33.0	33.0	32.7	32.6	32.6	32.3	32.2	32.1	32.0	31.8	31.7	31.7	31.7	31.6	31.6	31.6	31.5	31.5
180	33.4	33.3	33.0	33.0	32.9	32.6	32.5	32.4	32.3	32.2	32.1	32.0	32.0	32.0	31.9	31.9	31.8	31.8
190	33.8	33.7	33.4	33.3	33.2	32.9	32.8	32.7	32.6	32.5	32.4	32.4	32.3	32.3	32.2	32.2	32.1	32.1
200	34.1	34.0	33.7	33.6	33.5	33.2	33.1	33.0	32.9	32.8	32.7	32.6	32.6	32.6	32.6	32.5	32.4	32.4
212	34.5	34.4	34.2	34.1	33.9	33.6	33.5	33.4	33.3	33.2	33.1	33.0	33.0	33.0	32.9	32.9	32.8	32.8

THE ANCHORING OF PIPE LINES

Floor Anchor for Large Pipe Lines

The anchoring of pipe lines carrying steam and hot condensate always presents a problem and each anchor is generally custom designed to meet a certain condition. If the building structure exists, its steel frame must be checked to see if it will take the additional thrust of thousands of pounds of pressure and torque imposed upon it by the expansion of the pipe lines at the anchor points. If it is a new structure, the structural engineer must be advised of the additional loads that will be imposed upon certain members.

Welded structural steel members and plates lend themselves very easily to the formation of anchors and have been quite effectively used for many years.

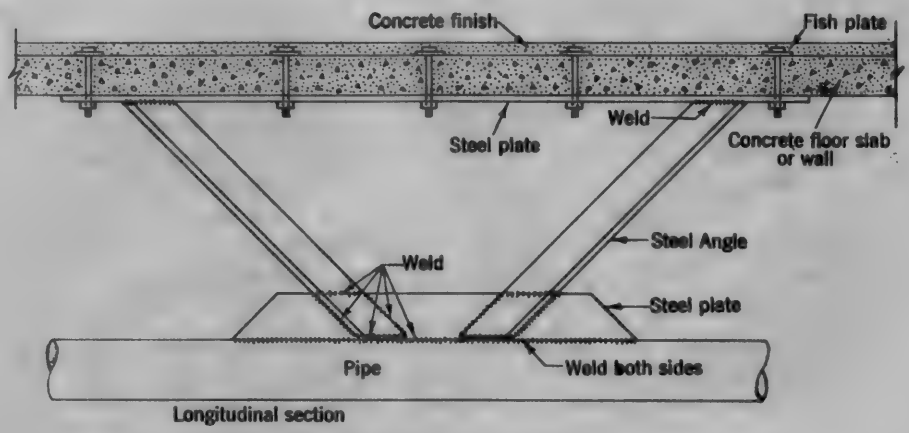


FLOOR ANCHOR FOR LARGE PIPE LINES

Above sketch shows an anchor constructed of steel plate and bolted to a concrete pier. This type of anchor lends itself quite well to pipe lines run close to the floor.

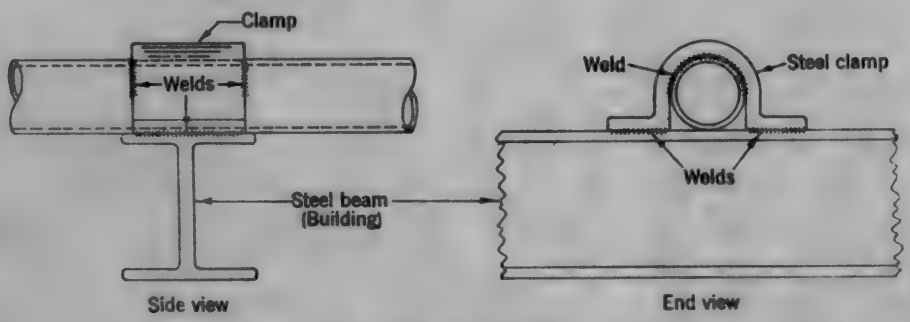
THE ANCHORING OF PIPE LINES

Ceiling or Side Wall Anchor; Clamp Type Anchor



CEILING OR SIDE WALL ANCHOR
(Where pipe is not close to ceiling or side wall)

Drawing above shows a ceiling or side wall anchor with the anchor frame bolted through the slab at the ceiling or the side wall. All members are welded.



CLAMP TYPE ANCHOR

Above diagram indicates a simple clamp type anchor. This anchor is used where it is possible to run the pipe line close to a member of the building frame and weld to same. The beam shown could also be a supplementary member supported between two beams of the building frame. The anchor may also be inverted.

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DETAIL SHEET—AIR CONDITIONING, HEATING AND VENTILATING

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Theoretical aspects of weather control for hot water systems:

Curves for Outdoor Reset

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Required water temperatures are not a straight-line function of outside air temperature. The author shows how to determine the set points on the curve resulting when water temperature is plotted against outside temperature.

THE PRIMARY OBJECTIVE of weather control of hot water heating systems is to adjust the hot water temperature in a manner to cause the convector output exactly to balance the building heat loss so as to maintain the desired indoor temperature. The expression of this result is a curve of outdoor temperature versus hot water temperature leaving the convertors or boiler. The theoretical development of this curve and the relationship of factors affecting the curve is the subject of this article.

It is first necessary to examine the calculation of building heat loss. The design heat loss of a space depends on the desired room air temperature, design outdoor air temperature, and the conductance of the exterior walls and other areas losing heat. Hence,

$$q_{ld} = K_1A_1\,(t_r - t_{od}) + K_2A_2\,(t_r - t_{od}) + \ldots . = \Sigma\, K_nA_n\,(t_r - t_{od}) \qquad (1)$$

where q_{ld} = design heat loss, Btu per hour,
K = conductance of a specific heat losing surface, Btu per (hour) (deg. temp. difference),
t_r = design room or inside air temperature,
t_{od} = design outside (minimum) air temperature.

Assuming that K, the conductance of the construction (including allowance for infiltration), remains unaffected by the variation in outdoor temperature over the range involved, then,

$$q_l = K\,A\,(t_r - t_o) \qquad (2)$$

where q_l = heat loss at t_o,
t_o = some outdoor air temperature.

Thus the fraction of the design heat loss at any given outdoor temperature results from dividing Equation 2 by Equation 1:

$$q_l/q_{ld} = (t_r - t_o)/(t_r - t_{od}) \qquad (3)$$

Convectors are sized on the basis of Equation 1. This selection is made for a specific average water temperature in the convector, denoted by t_{wd}. The output of convectors is generally accepted to follow the I-B-R correction equation:

$$q_o = q_{os}\left(\frac{t_w - t_a}{215 - 65}\right)^{1.5} \qquad (4)$$

where q_{os} = "standard" rating of the convector for 1 psi steam and 65-deg entering air,
t_w = average temperature of the heating water,
t_a = entering air temperature.

If q_{od} is taken to represent the selected output of the convector at some design water temperature, t_{wd}, and room air temperature, t_r, then substituting in Equation 4:

$$q_{od} = q_{os}\left(\frac{t_{wd} - t_r}{215 - 65}\right)^{1.5} \qquad (5)$$

Hence the fraction of the design heat release into the room is obtained by dividing Equation 4 by Equation 5 with the further assumed simplification that the entering air temperature is substantially room air temperature.

$$\frac{q_o}{q_{od}} = \left(\frac{t_w - t_r}{t_{wd} - t_r}\right)^{1.5} \qquad (6)$$

Note that the exponent 1.5 applies to convectors. For finned-tube radiators the exponent is 1.4.

Since at equlibrium the fraction of the design heat release from the convectors must equal the fraction of the design heat loss, then Equation 3 may be set equal to Equation 6, with one important qualification, that the convectors have been selected exactly to offset the design heat loss at the design outdoor temperature (t_{od}) and with an average water temperature of t_{wd}. Therefore:

$$\frac{t_r - t_o}{t_r - t_{od}} = \left(\frac{t_w - t_r}{t_{wd} - t_r}\right)^{1.5} \qquad (7)$$

Equation 7 relates the water temperature (t_w) to the outdoor air temperature (t_o). This can be rearranged to give:

$$t_w = t_r + (t_{wd} - t_r)\left(\frac{t_r - t_o}{t_r - t_{od}}\right)^{2/3} \qquad (8)$$

This is the fundamental relationship which the control system is called upon to satisfy.

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Most manufacturers now tabulate the Btu per hour output of their convectors at various average water temperatures, and all radiators on any system are selected at the same average water temperature, which becomes t_{wd} in Equation (8).

A graph of Equation 8 is shown as Curve *A* in Fig. 1 for a given set of design values. If the *average* water temperature in the convectors were to be maintained at the values shown for Curve *A*, then the building heat loss (neglecting internal gains) would be exactly offset by the convector output. Since the sensing element for hot water temperature control is usually located in the convertor discharge piping, then this discharge temperature must be set higher than the average temperature in the convectors. If the convectors are designed for a 20-deg drop in water temperature at design outdoor temperature, then the mean temperature must be 10 deg below the convertor discharge temperature under these conditions. When the outdoor air temperature equals the room air temperature there should be no temperature drop in the water through the convectors. The water temperature drop through the convectors is a linear function of the heat loss and therefore of the outdoor temperature. Thus the convertor discharge temperature may be plotted as shown on Curve *B* of Fig. 1 by adding the necessary increase in water temperature to account for the mean drop through the radiators.

The next step is to determine the required performance of the control mechanism for the hot water temperature. Fig. 2 shows the desired temperature relationship (Curve *B* of Fig. 1) and superimposed control lines C_1, C_2 and C_3 of a straight line controller. Control line C_1 satisfies two points on Curve *B*, at the outside design air temperature and at the room air temperature. Notice, however, that at all intermediate outdoor temperatures, control line C_1 lies below the required water temperature. For example, at an outdoor temperature of 40 deg control line C_1 lies 17 deg below the required curve. If control line C_3 which is tangent to Curve *B* at the outdoor design temperature, is examined, it is seen that for

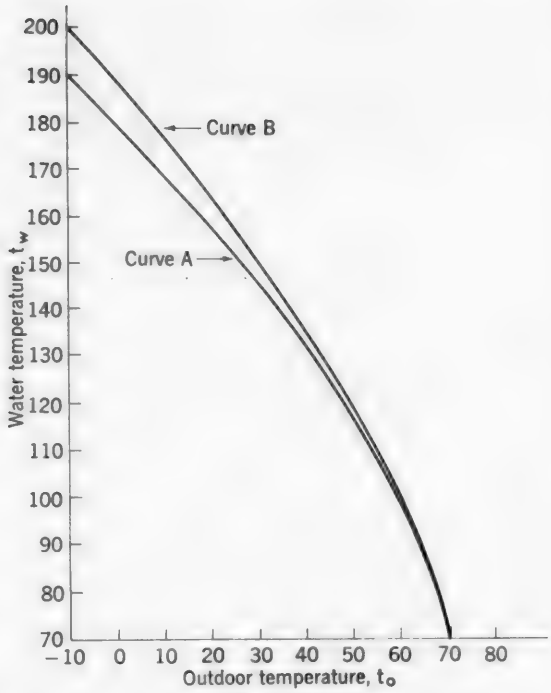

Fig. 1. Graph of equation 8 shown here by Curve A, while Curve B is the temperature of the water leaving the converter. Data for these curves, as well as those in Fig. 2, are from the example given later in the article; Curve A is from Step 2, Curve B from Step 4.

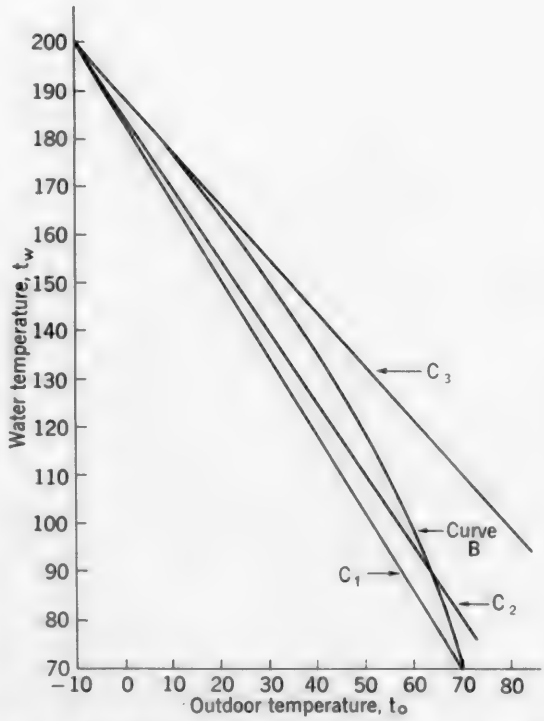

Fig. 2. Relationship of Curve B from Fig. 1 to three straight-line control arrangements, C_1, C_2 and C_3.

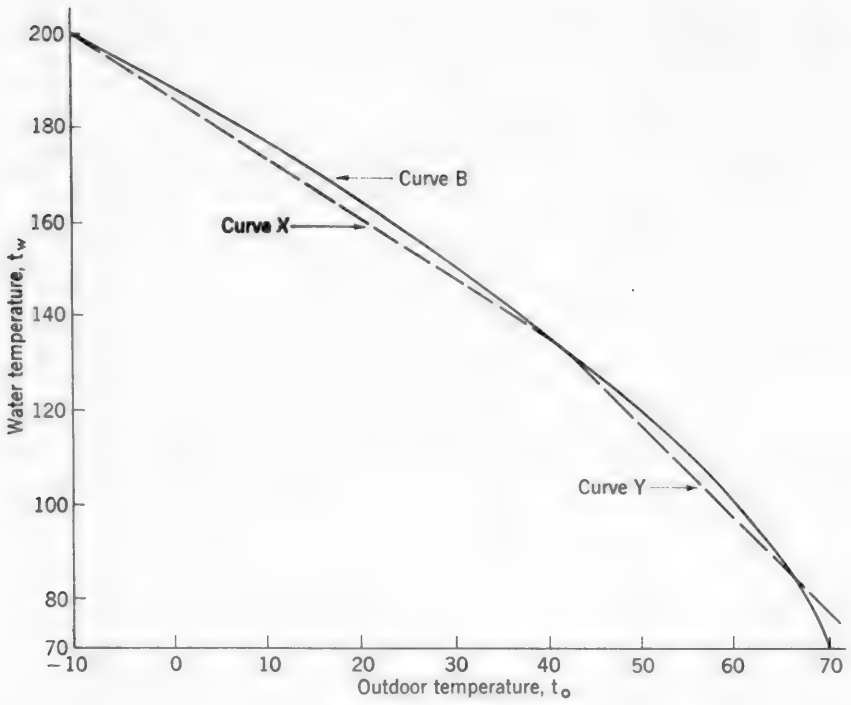

Fig. 3. Curve B can be more closely followed if two control lines, as shown by Curves X and Y, are employed.

all temperatures above the design outdoor air temperature, the water temperature will exceed the water temperature required to effect heating. This control line is only 6 deg above the required water temperature at a 40-deg outdoor temperature but 40 deg above Curve *B* at an outside air temperature near room temperature. Control line C_2 represents a compromise between the underheating of line C_1 and the overheating of line C_3. Note that underheating, corresponding to 11 deg water temperature difference, does occur at 40 deg outside and overheating to the extent of 10 deg water temperature takes place at 70 deg. However, the magnitude of the difference between control line C_2 and the theoretically required water temperature (Curve *B*) is less than that for C_1 or C_3.

The effect of the magnitude of water temperature deviation upon system performance will now be considered. To evaluate this effect, differentiate Equation 8 with respect to t_w and t_r and obtain:

$$\frac{\delta t_r}{\delta t_w} = -\frac{1}{\left(\frac{t_{wd}-t_w}{t_{wd}-t_r}\right) + \frac{2}{3}\left(\frac{t_{wd}-t_r}{t_w-t_r}\right)^{\frac{1}{2}} \left(\frac{t_o-t_{od}}{t_r-t_{od}}\right)\left(\frac{t_{wd}-t_r}{t_r-t_{od}}\right)} \tag{9}$$

where the term definitions are, for convenience, repeated as:

t_r = design room air temperature,
t_{od} = design outside air temperature,
t_{wd} = average water design temperature,
t_w = water temperature at a specific outside temperature,
t_o = a specific outside temperature.

From a study of Equation 9 it may be seen that as the water temperature approaches the room temperature, the value of $\frac{\delta t_r}{\delta t_w}$ decreases to approach zero. As the water temperature approaches the design value, $\frac{\delta t_r}{\delta t_w}$ increases in proportion to $\frac{1}{t_o - t_{od}}$. Since under the conditions that the water temperature approaches the design value, the outdoor air temperature is also approaching its design value, the change in room air temperature with respect to water temperature increases. It therefore follows that a greater deviation in water temperature can be permitted for a high outdoor temperature than for a low outdoor temperature. In fact, a theoretical deviation in room temperature can be calculated for an assumed set of conditions since

$$\Delta t_r = \frac{\delta t_r}{\delta t_w}\,\Delta t_w$$

It is seen by reference to Fig. 2 that the desired control limits of room temperature may be incapable of achievement over a wide range. Indeed, many systems are shut down in mild weather due to excessive temperature. That this may occur is obvious from reference to line C_3 on Fig. 2. In fact, even the deviation of control line C_2 from the required water temperature may under some conditions be excessive. A logical correction is the introduction of two control lines as shown by curves *X* and *Y* in Fig. 3.

When the heated space is subjected to internal heat release, such as from lights and motors, it is necessary to design for a lower water temperature. Assume

that the internal gain is constant at some value which will be called q_i. This serves to reduce the actual heat loss q_l (Equation 2) such that the net loss $q_{nl} = q_l - q_i$. It is the net loss for which the radiators or convectors must be designed. Equation 3 then becomes:

$$\frac{q_{nl}}{q_{ld}} = \frac{q_l}{q_{ld}} - \frac{q_i}{q_{ld}} = \frac{t_r - t_o}{t_r - t_{od}} - \frac{q_i}{q_{ld}} \qquad (14)$$

where q_i = internal heat gain, a constant
q_l = actual heat loss
q_{nl} = net heat loss $(q_l - q_i)$
q_{ld} = design heat loss

But since q_i has been assumed to be constant and q_{ld} is constant then the second term has a constant value independent of t_r or t_o. A fictitious term may be employed to replace q_i/q_{ld}, defined as:

$$\frac{q_i}{q_{ld}} = \frac{t_o' - t_o}{tr - t_{od}} \qquad (15)$$

where t_o' is a fictitious outdoor temperature equivalent to the release of q_i internal heat. Substituting Equation 15 in Equation 14:

$$\frac{q_{nl}}{q_{ld}} = \frac{t_r - t_o'}{t_r - t_{od}} \qquad (16)$$

The fictitious outdoor temperature t_o' is defined by a rearrangement of Equation 15:

$$t_o' = t_o + (t_r - t_{od})\left(\frac{q_i}{q_{ld}}\right) \qquad (17)$$

In this expression, q_i is negative, being opposite in effect to the design heat loss q_{ld}. Referring to Fig. 2, note that the abscissae of Curve B are shifted for this internal gain by an amount

$(t_r - t_{od})\frac{q_i}{q_{ld}}$, a constant over the entire range

of outdoor temperatures. Hence the effect of internal heat gain is to simulate an increased outdoor temperature, thus requiring a correspondingly lower water temperature.

The foregoing development becomes somewhat laborious to apply as a routine design procedure, so that the following simplified technique is presented. For convenience in calculating, Equation 8 may be rearranged to:

$$t_w = t_r + M(t_r - t_o)^n \qquad (18)$$

where

$$M = \frac{t_{wd} - t_r}{(t_r - t_{od})^n} \qquad (19)$$

Note that M is determined by (a) the design water temperature upon which the radiation is sized, (b) the design room temperature, and (c) the design outdoor temperature. Therefore M is readily calculated for any specific set of conditions and consequently the graph of water temperature versus outdoor temperature can be prepared.

Example

Let the following represent given design conditions for a system of convector radiators:

Outside design air temperature, $t_{od} = -10$ deg F,
Room air temperature, $t_r = 70$ deg,
Design average water temperature in radiators, $t_{wd} = 190$ deg,
Design temperature drop through radiators = 20 deg.

It is required to prepare a graph of (1) average water temperature versus outdoor temperature and (2) converter control set point temperature versus outdoor temperature.

Step 1. Compute M for the design conditions. This may be done mathematically through:

$$M = \frac{t_{wd} - t_r}{(t_r - t_{od})^{1/3}} = \frac{190 - 70}{[70 - (-10)]^{1/3}} = \frac{120}{18.57} = 6.46$$

or more simply through the use of Fig. 4. In using Fig. 4, let $t_w = t_{wd}$ and $t_o = t_{od}$; enter $(t_w - t_r)$ at $(190 - 70) = 120$; move horizontally to $(t_r - t_o) = [70 - (-10)] = 80$; drop vertically and read $M = 6.5$.

Step 2. Along the vertical, $M = 6.46$, tabulate the value of $t_w - t_r$ at the intersection of the $t_r - t_o$ diagonals as follows in columns A and B:

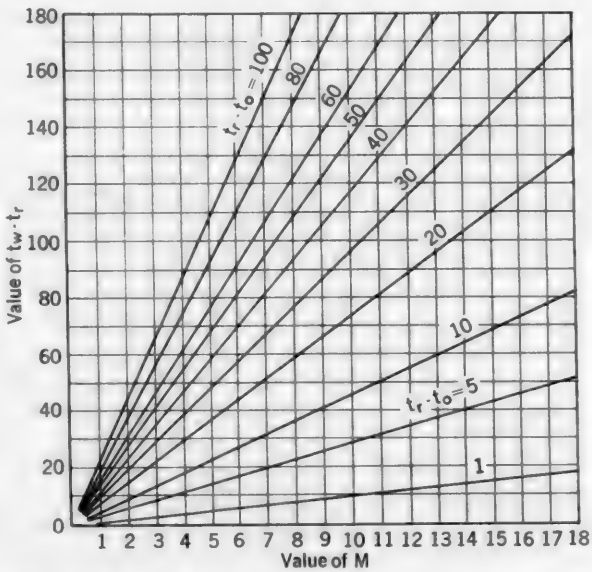

Fig. 4. Graph for determining water temperature, t_w for convectors given outside air temperature t_o, room air temperature t_r and value of M.

Col. B	Col. A	Col. C	Col. D
$(t_r - t_o)$	$(t_w - t_r)$	(Col. A + 70)	(70 − Col. B)
80	120	190	−10
60	99	169	10
50	89	159	20
40	76	146	30
30	63	133	40
20	48	118	50
10	30	100	60
5	19	89	65
0	0	70	70

Step 3. Correct t_w (Column C) for converter reset as follows: If the average temperature for the water at design is 190 deg, and the drop through the radiator is 20 deg, then the entering temperature should be $190 + \frac{20}{2} = 200$ deg at design outside temperature. Therefore add the following correction to t_w average:

$$\frac{10\,(70-t_o)}{70-t_{od}} = \frac{10}{80}(70-t_o) = \frac{70-t_o}{8} \text{ or } \frac{\text{Col. } B}{8}$$

Step 4. Tabulate the converter set point temperature and outside temperature:

Col. D	Col. E	Col. C	Col. F
t_o	Correction (Col. $B \div 8$)	t_w	t_w Control (Col. C + Col. E)
−10	10	190	200
10	7.5	169	176.5
20	6.2	159	165.2
30	5.0	146	151.0
40	3.8	133	136.8
50	2.5	118	120.5
60	1.2	100	101.2
65	0.6	89	89.6
70	0	70	70.0

Step 5. Plot the control curve B—as shown in Fig. 3.

Step 6. Estimate the best control line or lines for minimum deviation from the curve.

Step 7. If desired, compute room temperature deviation at one or several points. For the example and the selected control lines shown in Fig. 3 the water temperature required at an outdoor temperature of 15 deg is approximately 2 deg above the control line. For this calculation, using Equation 9, it is necessary to use t_w as the average water temperature, interpolated from Column C. This is 164 deg at 15 deg outside. Substituting in Equation 9:

$$\frac{\delta t_r}{\delta t_w} = \frac{1}{\left(\frac{190-164}{190-70}\right) + \frac{2}{3}\left(\frac{190-70}{164-70}\right)^{1/2}\left(\frac{15-(-10)}{70-(-10)}\right)\left(\frac{190-70}{70-(-10)}\right)}$$

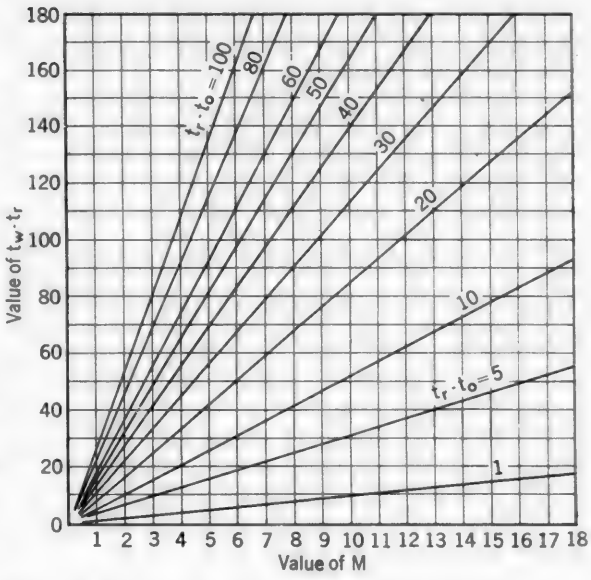

Fig. 5. Graph for determining t_w when fin-tubes are used.

$\frac{\delta t_r}{\delta t_w} = 1.75$ deg room temperature change per degree water temperature change.

Δt_r deviation of room temperature at 15 deg outdoors due to control line error = 2 × 1.75 = 3.5 deg.

At 55 deg, $\frac{\delta t_r}{\delta t_w} = 0.475$ deg room temperature change per degree water temperature change.

Δt_r deviation of room temperature at 55 deg outdoors due to 2 deg control line error = 2 × 0.475 = 1 deg, approximately.

Adding another condition to the example, assume that the internal heat gains into the space to be heated amount to 10% of the design heat loss from the space. (This must be calculated from more complete design data for the problem.) The following steps correct the water temperature:

Step 8. Substituting in equation (17):

$$t_o' = t_o + [70 - (-10)]\,(-.1/1.0) = t_o - 8$$

Then the tabulated values from Step 4 become:

t_w control	t_o
200.0	−18
176.5	2
165.2	12
151.0	22
136.8	32
120.5	42
101.2	52
89.6	57
70.0	62

Design of Fan Inlet Boxes

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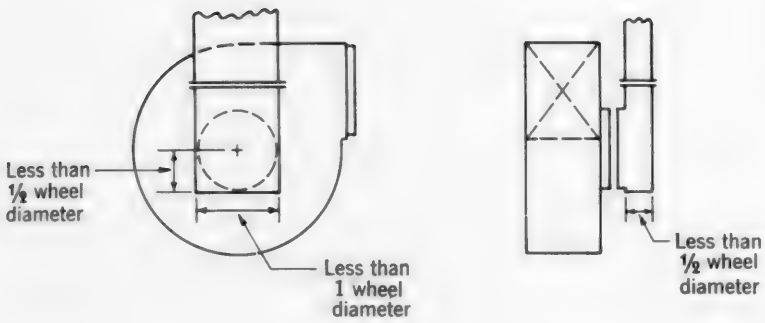

Fig. 1. A poorly proportioned inlet box. Fan wheel diameter is used as basis of comparison. Fan capacity will be cut.

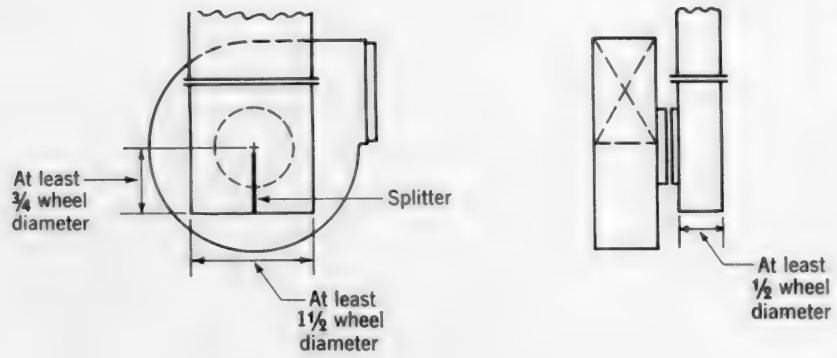

Fig. 2. Good inlet box design for backwardly inclined centrifugal fans. For other types, proportions vary slightly

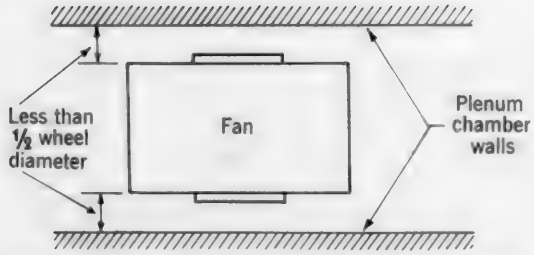

Fig. 3. Poor layout of double inlet fan in plenum chamber. Too little space between walls and inlet.

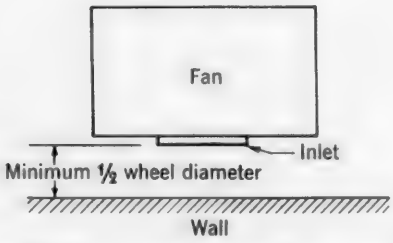

Fig. 4. Showing minimum clearance between wall and inlet.

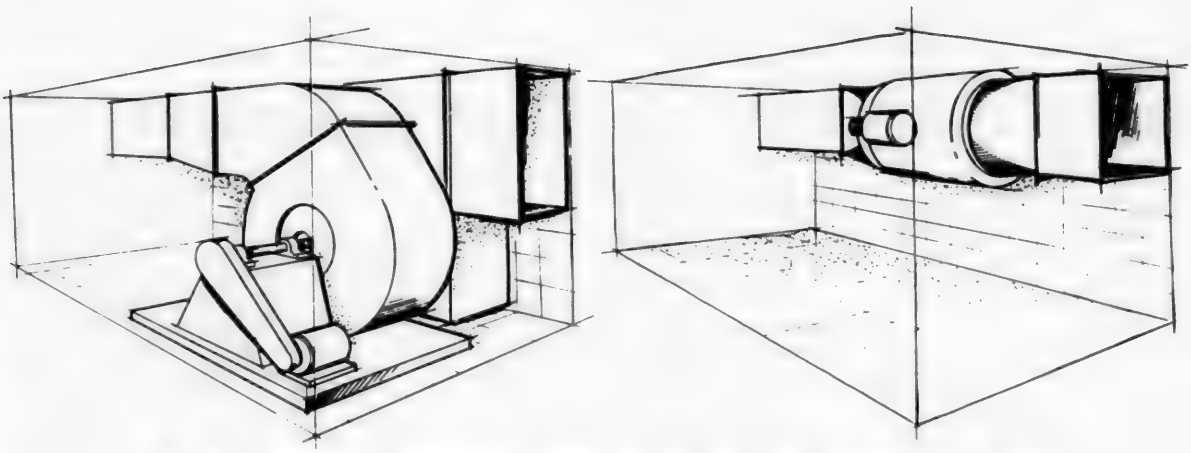

Fig. 5. Demonstrating space-saving feature of the new in-line centrifugal fan (right) over the conventional scroll-type centrifugal at left.

IN MANY INSTANCES, particularly in ventilation and air conditioning, inlet box connections to scroll-type centrifugal fans are being used. Equipment rooms or other space limitations may prevent the use of inlet elbows and a common and practical solution is the inlet box. An inlet box is a short rectangular portion of duct installed adjacent to the inlet side of the fan casing with the fan inlet tapped into the broad side of the box. Although heavy duty and power apparatus fans have been equipped with inlet boxes as standard equipment for many years, some fan manufacturers now furnish inlet boxes as an accessory for their ventilating and air conditioning fans. A correctly proportioned box will reduce the over-all width of the installation to about 50 percent of an inlet elbow installation. Such a space saving cannot be ignored.

In our eagerness to fit the equipment into the allotted space, our impulse is to reduce the inlet connection box to what we think is a minimum. Reducing the inlet piece beyond actual minimum standards restricts the flow of air into the fan inlet and may not allow it to spread out in the box so that we do not have "standard" inlet conditions. ("Standard" inlet conditions, as defined in the preceding article on fan inlets, means that the flow into the fan is in straight lines all around the fan inlet to allow full usage of the inlet. If the inlet connection creates an air spin or otherwise changes the air pattern from straight line flow, it is termed "non-standard").

A poorly proportioned inlet box is illustrated in Fig. 1. For reference purposes, the fan wheel diameter is used as the basis of comparison since fan parts for different sizes are proportional to the wheel diameter. Note that the flow into the inlet is "non-standard" and accordingly the performance of the fan and system is reduced.

A correctly proportioned inlet box is illustrated in Fig. 2. The proportions as shown are correct for a backwardly-inclined centrifugal fan; for other types of wheel blading, the proportions are slightly different. The width, depth and thickness of the box are larger (than in Fig. 1) which improves performance. It is often recommended that a "splitter sheet" be installed at the far end of the inlet box to insure straight (i.e., no spin) air flow into that portion of the fan inlet.

It should be understood that the use of inlet boxes should be restricted to clean or fume-laden air only. Refuse, such as shavings or sawdust, or material being conveyed in the air stream, such as in pneumatic conveying systems, will fall out of the air stream in the box and clogging will finally result.

A similar space restriction often occurs in the use of double inlet fans. These fans are generally located in plenum chambers drawing air through conditioning coils and air cleaners and discharging into the duct system. Again, in our zealousness to minimize space, the walls of the plenum chamber may be placed too close to the fan inlets, as in Fig. 3. Similar problems may be encountered with single open inlet fans when they are placed too close to a building wall or obstruction such as a building column.

Under these conditions of installation, the performance of the fan will be reduced. In general, placing a wall too close to a fan inlet merely adds to the system resistance and reduces the air volume. A large building column, however, may set up turbulence or other entrance flow characteristics which may seriously reduce the performance, in addition to its restriction on the air flow.

To eliminate these problems, a good rule to remember is to place the fan inlet no closer than one-half a wheel diameter to the wall or other obstruction as indicated in Fig. 4.

A recent development in fan design affords another solution to the "space" problem that has been handled in the past by inlet boxes. The in-line centrifugal fan, which provides the same performance as conventional scroll-type centrifugal fans but with the added feature of in-line air flow, can provide considerable savings in space in many cases, especially where an in-line air flow duct arrangement is indicated. See Fig. 5.

How Much Does It Really Cost To Operate School Air Conditioning?

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THE INCLUSION OF AIR CONDITIONING SYSTEMS in school buildings is slowly increasing throughout the country. A few northern cities, such as Syracuse, are constructing year-round schools with central cooling plants to meet the demand for more efficient use of educational facilities on a 12-month basis.

In the opinion of many educators, however, the trend toward air conditioning is far too slow, and they lay the blame on school boards with the "old fashioned" idea that cooling is a luxury. School boards, on the other hand, feel their responsibility toward taxpayers involves providing the maximum educational facilities at the most economical price, which they believe eliminates "unnecessary extras" such as year-round environmental control.

These board members would probably say that air conditioning was fine for the Phoenix area, but not for their particular location, which doesn't experience 120-degree summers, and that the enormous added expense of operating an air conditioning system could not be justified.

I believe a study made on all phases of the air conditioning program in four high schools in our district shows some rather unexpected results. Because of our fairly unique climatic conditions here in Arizona, the figures we have tabulated will not apply to most other sections of the country. They will, however, probably indicate the maximum range of operational cost since few sections of the United States match our temperatures.

First it is necessary to know something of our schools and their equipment. The study was made of the four high schools in our district which are completely air conditioned: Central, Carl Hayden, South Mountain and Camelback high schools.

We began our air conditioning program in 1956 with the installation of a gas-fired absorption unit at Camelback, and then South Mountain, both schools already in operation at the time of installation. The same type of equipment was part of original construction at Hayden and Central.

The operational cost study was made for the 1959 normal school calendar year (Jan.-June, Sept.-Dec.), although some of the schools operate on a 12-month basis.

A brief description of each school will give an idea of the scope of the school complex on which the study is based.

Camelback High School

This school, as with all the schools in the study, is constructed on an "open plan." The buildings contain 134,947 square feet, and are one and two-story rectangles with flat overhanging roofs to provide shade protection from the sun. The classroom units, administration building and auditorium-cafeteria are connected by covered walkways.

Approximately 2,200 students attended class here during 1959 on a double session which lasted from 7:30 a.m. to 5:00 p.m. This school now operates almost a full 12-months, including summer school for make-up and enrichment courses.

Central refrigeration is supplied by a 430-ton Carrier absorption unit. It is supplied by two Kewanee 150-horsepower H.R.T. boilers operated at 40 psi steam pressure. It utilizes a double-duct system for distribution, controlled by individual room thermostats.

The cost of the complete heating system was $394,690, or $2.82 per square foot. The absorption machine was installed later for $120,000, or under 89 cents per square foot. The expenditure for absorption cooling equipment amounted to $50.25 per student station.

Labor costs for maintenance during 1959 were $966.66. This high figure here, and in the following three schools, is explained by the fact that most of this expense was incurred for cleaning and applying protective material to the tube sheets to stop corrosion resulting from the extremely hard water we have in this section of the country. Results of this work were satisfactory and will not be repeated each year.

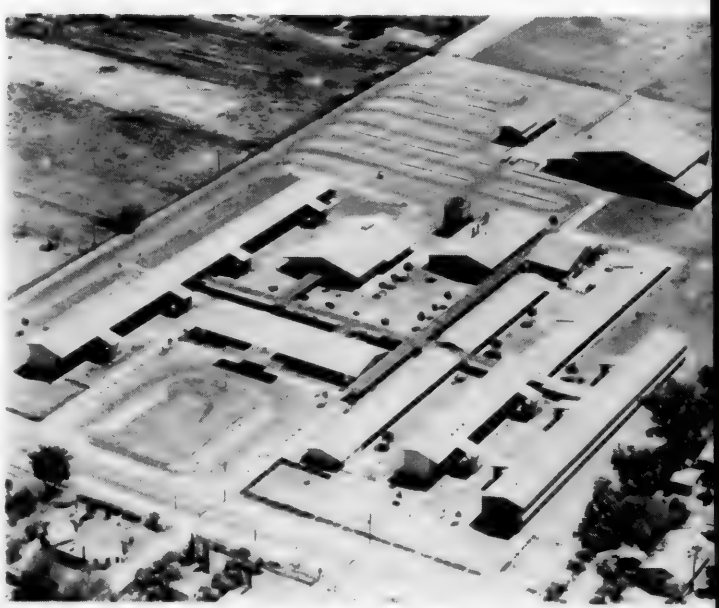
Also included in the 1959 figures is labor cost for the first major service and inspection of the absorption units since their installation, another expense which will not be incurred each year.

The cost of material for maintenance and replacement parts was $35.21, based on $140.85 worth of parts used by all four absorption units. These were the first parts used in three years, and were drawn from our stockpile of spare parts on hand. We had $744.70 worth of parts not yet used at the end of 1959.

The air conditioning system was used for a total of 80 days during calendar 1959, primarily during April, May, September and October. The total cost of operating the system was $4,653.46, or $2.08 per student for the entire year. This amounts to just over 2½ cents per student per day to maintain a comfortable learning environment, based on a gas rate of $.46/MCF.

• • •

South Mountain High School



This school is composed of 123,257 square feet in 12 buildings, and is in many ways similar to Camelback High. A 330-ton gas-fired absorption air conditioner was added to existing facilities under another separate contract of $120,000. The initial heating contract, which included two Spencer 15-pound H.R.T. boilers, was $343,440. This made the square-foot cost of heating and cooling South Mountain $2.78 and 98 cents, respectively.

The per student station cost of the air conditioning system here was $56.25, the highest of our four schools. Non-recurring labor costs (as explained above) were also high for this school, $1,126.48.

Over 1,850 students were enrolled in 1959, when air conditioning was used for 55 days of the normal school year. The cost of operating the system was $2,443.75, which amounted to $1.32 per student for the year or 2.4 cents per student per day.

Carl Hayden High School

This school consists of seven major buildings, and was the first to be constructed with gas-fired absorption air conditioning as part of original equipment, so that fan coils, ventilation cycle, etc., were designed into the original buildings.

The reason for the selection of absorption-type air conditioning operated by natural gas-burning boilers, incidentally, began as a matter of economics. Boiler systems capable of handling the absorption machine were already operating in the first two schools, so it was less expensive to cool by absorption. This type of equipment was installed in the two new schools, however, because we were most satisfied with both the functioning of the cooling system and economy of its operation.)

The initial cost of the heating system was $250,000, and consisted of two Titusville 217-horsepower H.R.T. boilers operating at 40 psi steam pressure. The central refrigeration plant was installed for only $75,000, or $40.10 per student station. Square foot figures were $2.19 for heating and 65 cents for cooling equipment.

The 330-ton absorption machine cooled 113,955 square feet of space at Hayden High for 72 days at a cost of $3,961.40. This school was on double session during 1959, however, with classes meeting from 7:30 a.m. to 5:00 p.m. Under these circumstances it cost $1.51 per student for cooling, or just 2.1 cents per day per pupil. Non-recurring maintenance was $794.50.

Another 257-ton Carrier absorption machine will be added to the system to accommodate additions. It will be operated by existing boiler equipment.

• • •

Central High School

This is our newest high school, conceived by John Sing Tang, A.I.A., and formally accepted by the Board of Education in January, 1958. It has a 99,852 square foot area (covered walkways not included) and was built for $2,151,735, or $21.55 per square foot. Present mechanical equipment is adequate for future expansion to a 2500-student school.

Its present enrollment is 1,517. The school is comprised of 48 classrooms, cafeteria, library, book store, gymnasium, administration area and boiler building.

Construction is similar to that of our other schools —ground supported concrete floors, nine-inch brick walls, and flat, mopped-on gravel surface roof with two-inch rigid insulation over a concrete deck. Windows are projected-type aluminum.

The air conditioning system is high pressure double-duct for classrooms, and low pressure for cafeteria, shops and gymnasium. Air return is incorporated in the system, except for lavatories where direct power exhaust is used.

An air handling unit in each building is supplied with hot or chilled water from the central plant. Two 187-horsepower H.R.T. boilers supply both heat and domestic hot water, and power the 330-ton absorption refrigeration unit. The two boilers have a total rating of 12.9 million Btu. output.

Indoor-outdoor design temperatures were 70°-25° (winter) and 78°-108° (summer). Ventilation design ranged from five to 100% fresh air, depending upon outside temperature.

The firm of Lowry & Sorensen engineered the heating-cooling system, and the Valley Sheet Metal Company carried out the $406,000 contract, of which $80,000 was for the cooling plant; this was $52.75 per student station.

The cost of cooling during 82 days of double sessions at Central was $4,467.94, or $2.05 per student per year, 2.5 cents per student per day.

Maintenance labor for the survey year was $689.90, and the same $35.21 was charged for replacement parts.

SUMMARY OF INITIAL COSTS AND OPERATING EXPENSES TO AIR CONDITION FOUR PHOENIX HIGH SCHOOLS DURING 1959

SCHOOL	HEATING EQUIP.	COOLING EQUIP.	MAINT. LABOR	MAINT. PARTS	DAYS USED	COOLING FUEL COST	COST PER STUDENT/ YEAR	COST PER STUDENT/ DAY
CAMELBACK	$394,690	$120,000	$ 966.66*	$35.21*	80	$4,653.46	$2.08	$.026
S. MOUNTAIN	343,440	120,000	1126.48*	35.21*	55	2,443.75	1.32	.024
C. HAYDEN	250,000	75,000	794.50*	35.21*	72	3,961.40	1.51	.021
CENTRAL	326,000	80,000	639.90*	35.21*	82	4,467.94	2.05	.025
Average							$1.74	$.024
Total		$395,000	$3527.54*	$140.84*		$15,526.55		

* Non-recurring expense.

Other Cost Considerations

It was not necessary to include labor costs in calculating the operations of the four central absorption refrigerating plants. There was no increase in operating personnel when the units were put into use since existing plant operators were trained to operate, service and maintain this equipment.

We actually anticipate a reduction in cooling costs in the coming years. Economies will be made possible through operating experience gained on existing installations. In our future schools (our current plans are to air condition all high schools) we expect new developments in machine design and control will make for even more efficient cooling systems. In this connection it is interesting to note that in 1960, while operating Central through both summer school and summer night school, the total cooling gas fuel bill was just $5,934.

One other cost consideration is that of building maintenance. We have found that we can clean and maintain our air conditioned buildings with considerably less man power than our non-cooled buildings because they remain much cleaner from day to day.

Significance

What do the above statistics mean to our school district? It means that within the past few years we have learned we can create an environment for learning which never before existed. And we can do it at a low cost.

South Mountain High School, Phoenix, Ariz.

An average of just 2.4 cents per day provides cooling to each high school student. Just $1.75 per year for each pupil creates an environment without the distraction of physical discomfort, and in which, not incidentally, the teacher can function more efficiently and with high morale.

No one would think of building a school anywhere in the United States without a heating system of some sort. We have shown that for only 30 per cent of heating equipment cost, buildings can be converted to year-round structures which can be used during the warmest 30 per cent of the year. The 30 per cent figure will of course vary, as will all figures in this article, depending upon location and circumstances, but it is a guide.

National Significance

We believe our experience here in Phoenix can be useful to school boards and educators throughout the country for a number of reasons.

All our schools are built on the "open" or "finger" plan, as are most schools today. Future schools are planned, however, to be more compact. What we have done we have done with relatively conventional rooms. An even greater advantage is expected in reduction of cooling, heating, and maintenance cost by use of the compact school.

Our high schools are about average size, and run both single and double sessions, simplifying comparisons with schools in other communities.

And, most important, our Spring and Fall temperatures are close to the highest in the United States so all operating figures will probably be higher than those of cooler sections despite any gas rate differentials.

We believe that many educational officials will be surprised at the economy of operating a gas-fired absorption cooling system in a climate such as ours. We hope they may be motivated to take another look at refrigeration as a means of increasing the efficiency of their educational program and of their educational facilities.

Installed Plant Services Hold the Key To Raytheon's Transistor Reliability

RAYTHEON'S NEW SEMICONDUCTOR PLANT in Lewiston, Maine, has been designed to produce transistors so nearly perfect that they will be guaranteed with ten times the assurance of similar presently-available devices.

At the formal opening of the new 116,500 sq ft building Raytheon President Richard E. Krafve called the plant the "home of guaranteed transistors." He said it has been built to accommodate the new Lambda system, the government's highest criteria of quality and reliability measurement.

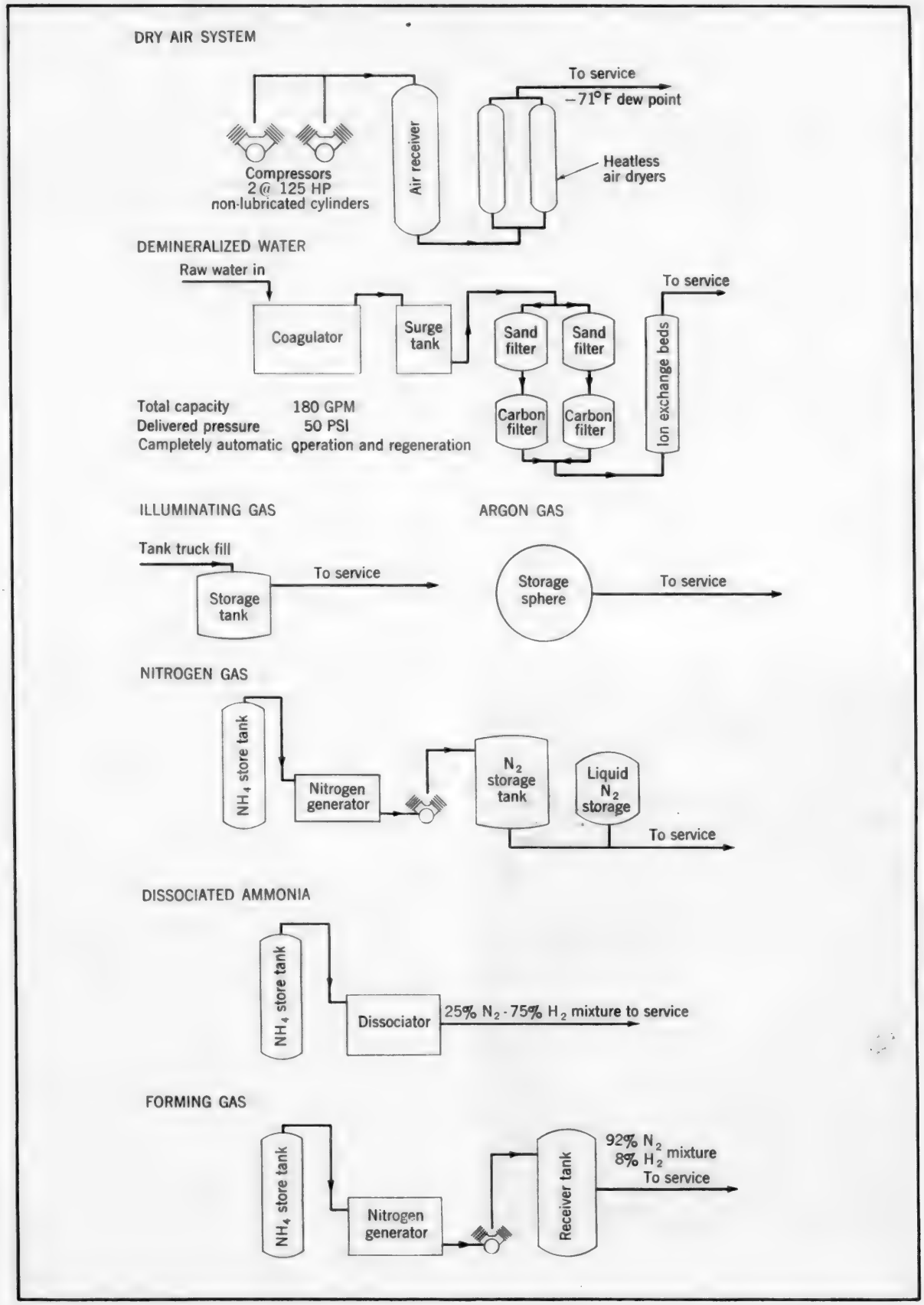
One of the principal features of the plant is a super-clean production area which boasts controlled temperature and humidity, highly-efficient dust control of personnel as well as atmosphere, flush dust-free ceilings and hard surface floors.

However, the key to higher reliability levels is the installed plant services supplying all requirements of manufacturing, assembly and testing functions. A 6400 sq ft utility area, shown in cover photo, contains the color-coded lines conducting these services from their various sources into a service loop passing underneath the main assembly area. These lines are tapped according to the requirements for each service.

The diagram on page 103 indicates schematically the source of the various services. The table on page 104 shows pipe sizes, types, and color coding.

Fig. 1. Personnel entering the super-clean production area must wash, don nylon smocks, and wipe their feet over vacuum cleaning devices in the floor to remove any dust particles. Note rows of "dry boxes" with protruding sleeves.

Fig. 2. These are the Primary Plant Services and their Sources.



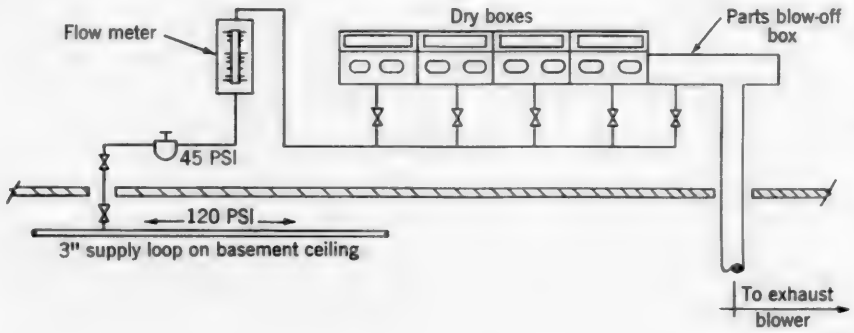


Fig. 3. This is the dry air piping scheme serving the dry boxes. Nitrogen can also be introduced to boxes should air dryness fall below specified standard.

SUMMARY OF PRIMARY PLANT SERVICES

Service	Distribution	Color Code
Demineralized Water	3" PVC	PVC Gray no paint
City Gas	3" Black Iron Sched. 40	Buff
Nitrogen	2" Black Iron Sched. 40	Green
Dissociated Ammonia	1¼" Black Iron Sched. 40	Yellow
Forming Gas	1" Black Iron Sched. 40	Light Green
Argon	1" Type K Copper	Purple
Dry Air	4" Seamless Steel	Dark Blue

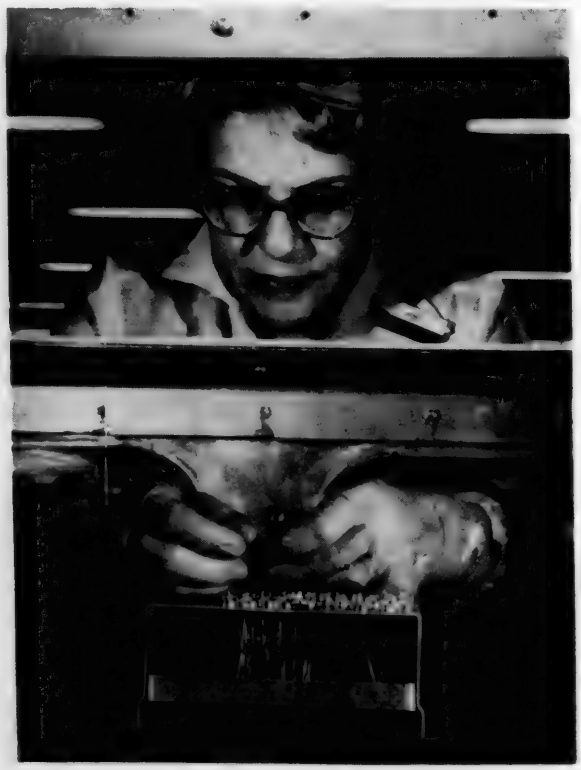


Fig. 4. Interior view of a dry box shows rubber-gloved hands assembling tiny transistor parts. Gloves and plastic sleeves are integral to the boxes.

Purchased gases are stored under pressure in a tank farm located behind the utility room. A special trench carries all piping underground from the tank farm to the utility room and from there to a service loop located under the main assembly area. The "loop" scheme was chosen to eliminate stagnant dead-ended pipe runs and to provide more uniform pressure distribution. Gases generated in the utility room (nitrogen and forming gas) are piped to storage and back to service loop via the trench.

End use of these services will not be examined in detail, except for those related to the miniature environments, known as "dry boxes", created within the super-clean area. The photo of Fig. 4 shows one of the glass-encased dry boxes which incorporate plastic sleeves and rubber gloves, through which dexterous fingers assemble tiny transistors.

The dry air piping scheme, shown in Fig. 3, distributes equal volume and pressure to all dry box units in a continuous line and tends to provide even dryness throughout. About 20% of the air for a given line is used to blow moisture from wet parts in the parts blow-off box. This blow-off air must then be immediately exhausted with the dry box air to the atmosphere to prevent moisture contamination of the dry box. The only air lost from the dry boxes to the room atmosphere occurs at the hand-hole sleeves.

Valves at dry box take-offs are locked in position after being adjusted to the point where all hand-hole sleeves are deflected equally. Welded and silver soldered connections reduce the possibility of moisture infiltration at joints. In the event that air dryness falls below the specified standard, nitrogen can be introduced without elaborate change-over through the use of a simple mixing valve arrangement.

ESTIMATING

Job Time Reference Data

Part 7 in this series on estimating continues the publication of a group of tables containing specific estimating data in terms of man-hours of labor. Covered this month is the application of insulation to piping and allie ! equipment.

ROBERT J. SMITH
Estimator
Sanderson & Porter, Inc.
New York, N. Y.

THE INSULATION KNOWN AS 85% MAGNESIA is possibly the oldest type of pipe insulation in use. It is long wearing, and can be used either with a hard cement finish, a canvas covering, or an aluminum skin or cover.

It can be used on any type of installation from the ordinary low pressure heating system to a high pressure installation for a power plant.

Tables 18, 19, 20 and 21 give the man-hours for installations up to 600 deg F only. They cover the installation of 85% magnesia insulation with a *canvas protective covering.*

TABLE 18 — 85% MAGNESIA PIPE INSULATION, 1 INCH THICK FOR A TEMPERATURE RANGE FROM 126 TO 299 DEG F — INSTALLATION TIME

Pipe Size in Inches	Straight Pipe	Bent Pipe	Screwed or Welded Fittings and Valves	Flanged Fittings and Valves	Pair of Flanges
	Man-hours per Foot		Man-hours		
½	.130	.195	.195	.455	.390
¾	.135	.197	.197	.473	.405
1	.135	.197	.197	.473	.405
1¼	.149	.224	.224	.522	.447
1½	.150	.225	.225	.525	.450
2	.158	.239	.239	.553	.474
2½	.169	.254	.254	.592	.507
3	.175	.263	.263	.613	.525
4	.189	.284	.473	.662	.567
5	.209	.313	.523	.734	.627
6	.226	.339	.565	.791	.678

TABLE 19 — 85% MAGNESIA PIPE INSULATION, 1½ INCHES THICK FOR A TEMPERATURE RANGE FROM 266 TO 387 DEG F — INSTALLATION TIME

Pipe Size in Inches	Straight Pipe	Bent Pipe	Screwed or Welded Fittings and Valves	Flanged Fittings and Valves	Pair of Flanges
	Man-hours per Foot		Man-hours		
½	.158	.239	.239	.453	.474
¾	.170	.255	.255	.595	.510
1	.177	.266	.266	.620	.531
1¼	.186	.270	.270	.63	.540
1½	.186	.279	.279	.651	.558
2	.201	.302	.302	.704	.603
2½	.207	.311	.311	.725	.621
3	.216	.324	.540	.756	.648
4	.240	.360	.600	.840	.720
5	.249	.374	.623	.872	.747
6	.255	.383	.638	.893	.775
8	.270	.401	.675	.945	.810
10	.321	.481	.803	1.124	.963
12	.351	.527	.878	1.229	1.053

TABLE 20 — 85% MAGNESIA PIPE INSULATION, 2 INCHES THICK FOR A TEMPERATURE RANGE FROM 340 TO 500 DEG F — INSTALLATION TIME

Pipe Size in Inches	Straight Pipe	Bent Pipe	Screwed or Welded Fittings and Valves	Flanged Fittings and Valves	Pair of Flanges
	Man-hours per Foot		Man-hours		
½	.170	.255	.255	.595	.510
¾	.180	.270	.270	.630	.540
1	.194	.291	.291	.679	.582
1¼	.207	.311	.311	.725	.621
1½	.219	.328	.328	.766	.657
2	.231	.347	.347	.809	.693
2½	.240	.360	.600	.840	.720
3	.253	.380	.633	.886	.759
4	.264	.396	.660	.924	.792
5	.272	.408	.680	.952	.816
6	.289	.435	.723	1.012	.867
8	.321	.482	.803	1.124	.963
10	.349	.524	1.571	1.222	1.047
12	.381	.572	1.715	1.334	1.143

TABLE 21 — 85% MAGNESIA PIPE INSULATION, 2½ INCHES THICK FOR A TEMPERATURE RANGE FROM 500 TO 600 DEG F — INSTALLATION TIME

Pipe Size in Inches	Straight Pipe	Bent Pipe	Screwed or Welded Fittings and Valves	Flanged Fittings and Valves	Pair of Flanges
	Man-hours per Foot		Man-hours		
½	.18	.270	.270	.630	.540
¾	.207	.311	.311	.725	.621
1	.219	.329	.329	.767	.657
1¼	.231	.347	.347	.809	.693
1½	.240	.360	.360	.840	.720
2	.255	.383	.383	.893	.765
2½	.264	.396	.396	.924	.792
3	.274	.411	.685	.959	.822
4	.291	.437	.728	1.019	.873
5	.298	.447	.745	1.043	.894
6	.312	.469	.788	1.092	.936
8	.361	.541	.903	1.264	1.083
10	.387	.581	1.742	1.355	1.161
12	.429	.643	1.931	1.502	1.287

TABLE 22 — 85% MAGNESIA PIPE INSULATION WITH ALUMINUM COVERING, FOR TEMPERATURES TO 300 DEG F — INSTALLATION TIME

Pipe Size in Inches	Straight Pipe	Bent Pipe	Welded Fittings and Valves	Flanged Fittings and Valves	Pair of Flanges	Insulation Thickness in Inches
	Man-hours per Foot		Man-hours			
½	.20	.60	.40	.80	.80	1
¾	.20	.60	.40	.80	.80	1
1	.20	.60	.40	1.06	1.00	1
1¼	.20	.60	.40	1.06	1.00	1
1½	.20	.60	.46	1.06	1.06	1
2	.22	.65	.40	1.06	1.06	1
2½	.22	.65	.80	1.85	1.06	1
3	.22	.65	.87	2.13	1.30	1
4	.23	.68	.98	3.20	3.20	1½
6	.30	.88	1.18	3.70	4.26	1½
8	.32	.95	1.90	4.50	4.72	1½
10	.33	1.00	2.00	5.30	5.30	2
12	.40	1.16	2.36	5.80	5.80	2

Reflective-Type Covering

This type of insulation consists of an inner layer of 85% magnesia covered with an aluminum skin or covering.

It is generally used on industrial or power plant installations, and provides not only a very striking appearance but also a long wearing job.

Tables 22, 23, 24 and 25 present man-hours for 85% magnesia insulation with *reflective-type covering* for installations up to 600 deg. Insulation thickness varies with pipe size, as well as with temperature, and is shown in last column of these tables.

TABLE 23 — 85% MAGNESIA PIPE INSULATION WITH ALUMINUM COVERING, FOR TEMPERATURE RANGE FROM 300 TO 400 DEG F — INSTALLATION TIME

Pipe Size in Inches	Straight Pipe	Bent Pipe	Welded Fittings and Valves	Flanged Fittings and Valves	Pair of Flanges	Insulation Thickness in Inches
	Man-hours per Foot		Man-hours			
½	.20	.60	.40	.80	.80	1
¾	.20	.60	.40	.80	.80	1
1	.20	.60	.40	1.06	.92	1
1¼	.20	.60	.40	1.06	.92	1
1½	.20	.60	.40	1.06	.92	1
2	.23	.60	.80	1.06	1.06	1½
2½	.25	.67	1.50	2.13	1.30	1½
3	.25	.73	1.43	2.25	1.58	1½
4	.27	.80	1.43	2.78	3.43	1½
6	.32	.95	1.43	3.20	4.50	2
8	.33	1.00	1.43	4.00	4.72	2
10	.50	1.20	5.00	6.67	5.00	2½
12	.50	1.25	5.80	8.00	5.83	2½

TABLE 24 — 85% MAGNESIA PIPE INSULATION WITH ALUMINUM COVERING, FOR TEMPERATURE RANGE FROM 400 TO 500 DEG F — INSTALLATION TIME

½	.23	.58	.80	.80	.80	1½
¾	.23	.58	.80	.80	.80	1½
1	.23	.58	.80	1.06	1.06	1½
1¼	.23	.58	.80	1.06	1.06	1½
1½	.23	.58	.80	1.06	1.06	1½
2	.25	.80	.80	1.06	1.27	1½
2½	.27	.80	1.52	2.13	1.45	2
3	.33	.83	2.12	2.13	1.85	2
4	.33	1.00	3.33	2.78	3.20	2
6	.44	1.08	4.50	5.33	3.20	2½
8	.53	1.60	4.76	9.27	5.00	2½
10	.62	1.83	5.50	11.50	6.67	2½
12	.65	1.93	6.67	14.80	8.00	3

TABLE 25 — 85% MAGNESIA PIPE INSULATION WITH ALUMINUM COVERING, FOR TEMPERATURE RANGE FROM 500 TO 600 DEG F — INSTALLATION TIME

½	.23	.58	.80	.80	.80	1½
¾	.23	.58	.80	.80	.80	1½
1	.23	.58	.80	1.06	1.06	1½
1¼	.23	.58	.80	1.06	1.06	1½
1½	.23	.58	.80	1.06	1.06	1½
2	.25	.80	.80	1.06	1.27	2
2½	.27	.80	1.52	2.13	1.45	2
3	.33	.83	2.12	2.13	1.85	2
4	.33	1.00	3.33	2.78	3.20	2
6	.44	1.08	4.50	5.33	3.20	2½
8	.53	1.60	4.76	9.27	5.00	3
10	.62	1.83	5.50	11.50	6.67	3
12	.65	1.93	6.67	14.80	8.00	3

Fiber Glass Insulation

The man hours shown on following page in Tables 26, 27 and 28 apply to fiber-glass pipe insulation with factory-applied fabric membrane.

The pipe covering is applied and banded in place, and the lap of the glass fabric membrane is cemented in place with a waterproof cement. Fittings are banded in place and finished with a waterproof cement. Either aluminum or brass bands can be used.

TABLE 26 — FIBER GLASS PIPE INSULATION, FOR TEMPERATURE RANGE FROM 50 TO 300 DEG F — INSTALLATION TIME

Pipe Size in Inches	Lineal Foot of Pipe	Screwed or Welded Fittings and Valves	Flanges (each)	Insulation Thickness in Inches
	Man-hours			
½	.20	.40	.40	1
¾	.20	.40	.40	1
1	.20	.40	.50	1
1¼	.20	.40	.50	1
1½	.20	.40	.53	1
2	.22	.40	.53	1
2½	.22	.80	.53	1
3	.22	.87	.65	1
4	.23	.98	1.60	1
6	.30	1.18	2.13	1
8	.32	1.90	2.36	1½
10	.33	2.00	2.65	1½
12	.40	2.36	2.90	1½

TABLE 27 — FIBER GLASS PIPE INSULATION, FOR TEMPERATURE RANGE FROM 300 TO 400 DEG F — INSTALLATION TIME

Pipe Size in Inches	Lineal Foot of Pipe	Screwed or Welded Fittings and Valves	Flanges (each)	Insulation Thickness in Inches
	Man-hours			
½	.20	.40	.40	1
¾	.20	.40	.40	1
1	.20	.40	.46	1
1¼	.20	.40	.46	1
1½	.20	.40	.46	1½
2	.23	.80	.53	1½
2½	.25	1.21	.65	1½
3	.25	1.21	.79	1½
4	.27	1.43	1.72	1½
6	.32	1.43	2.25	1½
8	.33	1.43	2.36	2
10	.50	5.00	2.50	2
12	.50	5.80	2.92	2

Equipment Insulation

Table 29 is based on the use of fiber glass curved segments. The segments are used in order to have the insulation conform to the contours of the vessels to be covered.

The curved segments are banded in place and are used with an asphalt cutback finish, consisting of a glass fabric membrane and asphalt combination.

TABLE 28 — FIBER GLASS PIPE INSULATION, FOR TEMPERATURE RANGE FROM 400 TO 600 DEG F — INSTALLATION TIME

Pipe Size in Inches	Lineal Foot of Pipe	Screwed or Welded Fittings and Valves	Flanges (each)	Insulation Thickness in Inches
	Man-hours			
½	.23	.80	.40	1½
¾	.23	.80	.40	1½
1	.23	.80	.53	1½
1¼	.23	.80	.53	1½
1½	.23	.80	.53	1½
2	.23	.80	.58	1½
2½	.25	1.50	.69	1½
3	.37	2.11	.88	1½
4	.40	3.33	1.34	2
6	.44	4.50	1.60	2
8	.50	5.00	2.50	2½
10	.56	5.25	2.92	2½
12	.58	6.41	3.45	2½

TABLE 29 — FIBER GLASS EQUIPMENT INSULATION — INSTALLATION TIME

Insulation Thickness in Inches	Minutes per Sq Ft	Man-hours per Sq Ft
1½	6.42	.107
2	6.78	.113
2½	7.26	.121
3	7.56	.126
3½	10.5	.175
4	12.1	.184

Finally, Table 30 covers the time required to install a square foot of 85% magnesia insulation on such types of equipment as boilers, pumps, or various vessels for containing liquids, etc.

The time shown covers the placing of wire, applying the asbestos cement, and applying the finish.

TABLE 30 — 85% MAGNESIA EQUIPMENT INSULATION — INSTALLATION TIME

Insulation Thickness in Inches	Minutes per Sq Ft	Man-hours per Sq Ft
1½	12.3	.205
2	12.7	.211
2½	13.1	.218
3	17.1	.285
4	18.0	.300

In November, Job Time Reference Data will cover ductwork installation and insulation.

How to Feed Evaporators—2

Last month, the superheat control expansion valve was discussed. This month, the low- and high-pressure float valves are covered.

NO MATTER HOW WELL designed a refrigerating system is, its proper operation depends on the refrigerant feed to the evaporator at a reasonable rate and its proper refrigerant distribution throughout the evaporator. Thus, the choice and application of the expansion valve is most important. Last month, we discussed particularly the superheat control expansion valve, commonly called a "thermal" expansion valve. It was discussed first because it is the most common, except in smaller systems, where capillary tubes prevail.

The superheat control expansion valve governs the flow to each evaporator in accordance with the superheat conditions at the end of that evaporator. It may therefore be used with a number of evaporators that form a part of a single refrigeration circuit. The low pressure float valve may be similarly used, with one controlling each evaporator, even when there is more than one evaporator forming a part of a single refrigerating system. Other expansion valves commonly used control refrigerant feed so as to keep the condenser empty or to keep a given pressure in the evaporators, with no attempt to assure that the refrigerant goes to any particular evaporator.

Low Pressure Float Valve

In the case of the low pressure float valve, refrigerant liquid flow is controlled by liquid level in the evaporator or in a chamber connected to the evaporator. The valve is so named because it is subjected to evaporator pressure. Its use is restricted to those evaporators in which there is a definite and measurable liquid level. Shell and tube types—with the refrigerant in the shell—fit these requirements. An evaporator with the refrigerant in the tubes can also be used in this manner if it is connected to a surge drum, in which the level is then maintained, as shown in Fig. 1. Refrigerant circulates from the surge drum to the evaporator and back, part of it evaporating during its travel through the evaporator.

Where the float is controlled by the level in the evaporator itself, a decrease in the rate of boiling in the evaporator is likely to result in an increase in the weight of liquid in the evaporator. This is true because, at the lower boiling rate, average liquid density is greater.

The denser liquid, being more buoyant, tends to raise the float and lower the refrigerant level. The effect on reducing the weight of refrigerant in the evaporator, however, is minimal.

Where the float is located in a chamber connected to the evaporator, as shown in Fig. 2, a lower rate of boiling in the evaporator itself will result in a somewhat lower level in the evaporator, but since this is balanced by the column in the chamber and the line connecting to it, which refrigerant is boiling rather slowly and constantly, the weight of refrigerant in the evaporator will not change appreciably. The

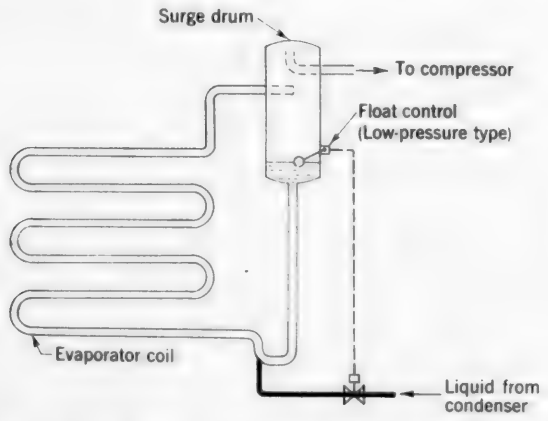


Fig. 1. Coil type evaporator arranged for flooded operation.

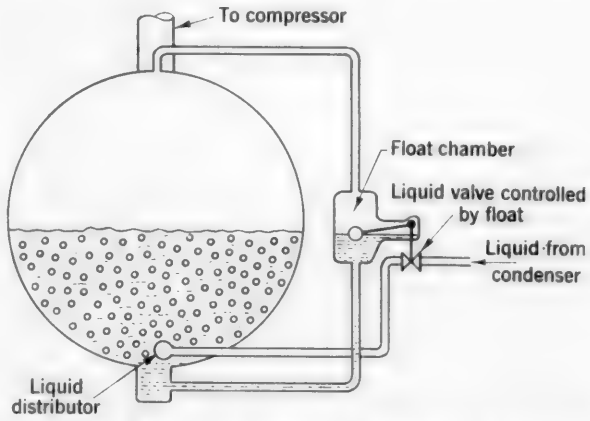


Fig. 2. Shell and tube evaporator with float in external chamber.

advantage of having a constant weight of refrigerant in an evaporator is that, when the load on the system increases abruptly, resulting in a higher evaporating rate, there is little likelihood that the evaporator will boil over.

It should be realized that when the float chamber is separate from the evaporator, as in Fig. 2, the liquid in the chamber and the lower part of the line is likely to contain a greater percentage of oil. This occurs because nearly pure refrigerant (as vapor) leaves the float chamber while a mixture of refrigerant and oil enters it. A considerable agitation in the chamber due to violent boiling in the evaporator will reduce this tendency to have a higher oil concentration in the float chamber. Sometimes an oil recovery device takes a mixture of oil and refrigerant from the chamber continuously in an attempt to keep this mixture as near as possible the same as that in the main evaporator. Care must be taken when this is done that the flow in the liquid connections to the chamber is at a very low rate compared with the size of the connection so that the pressure drop will be negligible. Otherwise this will result in a lower level in the float chamber. The importance of extremely small pressure drops in this line will be realized when it is considered that 0.25 psi loss corresponds to about a 6-inch level difference for halocarbon refrigerants and about 1-foot level difference for ammonia.

With proper design and sizing of connections between the float chamber and the evaporator, it is possible to have practically all oil in the float chamber and its connecting line. In this case, the float will be controlled by an oil level which will not be boiling. The level in the float chamber will result in the column of oil balanced against the column of refrigerant in the vaporator. With the halocarbon refrigerants, this will result in about 40% greater length of oil column than refrigerant column so that the level in the evaporator will be lower than it would if the float chamber and external column contained refrigerant. The reverse would be true with ammonia.

One manufacturer makes an expansion (level control) valve of the superheat control type in which heat is artificially applied to the bulb so that the bulb serves as a level indicator. When liquid surrounds the bulb, its temperature is that corresponding to saturation. When only gas surrounds it, the poorer heat transfer allows the bulb temperature to rise, simulating superheat. This makes a rather simple and dependable level control. However, it is important that the ratio of refrigerant to oil be the same in the mixture surrounding the level indicating bulb and in the evaporator itself.

High Pressure Float Valve

The high pressure float type expansion valve controls liquid flow by opening as liquid accumulates in either condenser or separate float chamber following the condenser, and closing as the liquid level falls. Its function, therefore, is to keep the condenser drained and thus keep as much of the liquid as possible on the low pressure side of the system. The float itself is subjected to condenser pressure, hence its name.

Since this valve merely transfers refrigerant from condenser to low side in response to the level in the condenser, it has no means of dividing the refrigerant correctly among two or more evaporators in the same circuit. For this reason, it can be used only where there is a single evaporator as a part of a given refrigerant circuit. Since the valve transfers all of the liquid from the high side to the low side, the amount of refrigerant in the system must be limited, as a surplus would not remain in the lower part of the condenser or the receiver but go to the evaporator.

The function of the high pressure float valve is very similar to a float trap in a steam heating system in that it keeps the condenser drained. Although this type of valve would not be satisfactory for many systems its value is often overlooked. If a system has a single evaporator and two or more condensers, this is a most useful control in that it insures that gas from one condenser cannot flow into the liquid line and result in holding up liquid in another condenser in which the pressure drop is greater. Basically, it is desirable that all condensers contain as little liquid as possible. The only place in a refrigerating system where liquid is of any use is in the evaporator. This type of valve assures that condition. Although a limited charge is required for this valve, there are definite advantages to a limited charge. Certainly from a first cost and possible loss standpoint, there is no reason to have an excess charge in a refrigerating system. A limited charge reduces the possibility of liquid slopover and damage to the compressor.

Orifices and Capillary Tubes

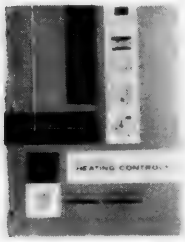
Orifices and capillary tubes perform basically the same function as the high side float. They are practical only for systems which operate at nearly constant capacity. They are sized to pass refrigerant liquid at a slightly greater rate than desired with the pressure difference available. This results in exhausting the liquid supply and gas reaching the restriction with a marked reduction in the weight rate of passing refrigerant so that liquid again accumulates at the entrance to the restriction.

The disadvantage of this type of control is that it allows some gas to leave the condenser and adds some heat to the low side. This loss is not large in a reasonably constant capacity system. The low cost, simplicity and dependability of this type of liquid feed control more than compensates for its slight inefficiency on the type of systems with which it is normally used.

Part 3 in this series next month will cover constant pressure expansion valves and distributors.

NEW LITERATURE

Use the prepaid yellow postcard in the back of the magazine for securing your copies of these catalogs.



Automatic Heating Controls

General Controls Co., Glendale, Calif., presents full information on its complete line of heating controls in a new 98-page catalog. Thermostats, gas valves, switching mechanisms, and time delay relays are discussed, along with scores of other products.

Circle **Item 1** on Inquiry Card

Draft Control

"The Control of Draft in Gas-Fired Equipment," a 32-page technical brochure offered by Field Control Div., Conco Engineering Works, Inc., Mendota, Ill., is prepared for those engaged in the design or installation of commercial-industrial gas-fired heating equipment.

Circle **Item 2** on Inquiry Card

Dust Filter Selection

An 8-page pamphlet offered by Mellon Institute, Pittsburgh, Pa., discusses filtration theory and offers a guide to selecting the filter medium to give optimum capacity and efficiency. Tells how electrostatic behavior of dust and filter fabric affect filter operation.

Circle **Item 3** on Inquiry Card

Water Conditioning Equipment

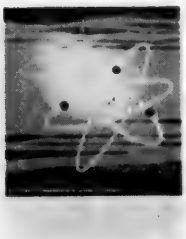
Portraying its "new era" in water conditioning, Tait Mfg. Co., Dayton, Ohio, offers a 16-page catalog featuring its line of Rapidayton water softeners and filters. Includes information on all models, illustrations, capacity tables, selection guides and charts.

Circle **Item 4** on Inquiry Card

Modern Plumbing, Heating, Piping

This 16-page booklet describing the Plumbing Industry Progress and Education Fund and its objectives is available from P.I.P.E., Los Angeles, Calif. It discusses significance of program, and covers such related fields as heating, ventilating, air conditioning and process piping.

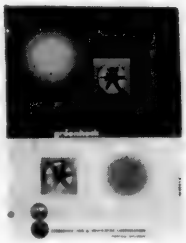
Circle **Item 5** on Inquiry Card



Nuclear Engineering

Burns and Roe, Inc., New York, N. Y., offers a 6-page brochure listing its activities in nuclear projects. Covers nuclear power generating stations, processing plants, and other nuclear facilities. Reference table lists reactor types, clients, and scope of each project.

Circle **Item 6** on Inquiry Card



Propeller Air Movers

An 8-page illustrated brochure on propeller air movers is available from Greenheck Fan & Ventilator Corp., Schofield, Wis. Contains construction features, dimensional data, electrical characteristics, and performance charts. Accessories are described and illustrated.

Circle **Item 7** on Inquiry Card

Saline Water Conversion

Water desalting is the theme of this 12-page booklet published by Aqua-Chem, Inc., Waukesha, Wis. Contains a brief history of the company, descriptions of the products they build and the markets they serve. Includes a partial list of installations.

Circle **Item 8** on Inquiry Card

Pipe Insulation

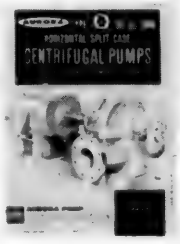
The Metal-On insulation system, an integrated pipe insulation, is described in an 8-page brochure, IN-217A, offered by Johns-Manville, New York, N. Y. Brochure illustrates and describes the system, how it is installed, and enumerates its many advantages to the user.

Circle **Item 9** on Inquiry Card

Humidity Instrumentation

A complete list of basic hygrometer instrumentation and systems for various industrial applications is presented in 8-page catalog available from Hygrodynamics, Inc., Silver Spring, Md. The basic components are enumerated with concise descriptions.

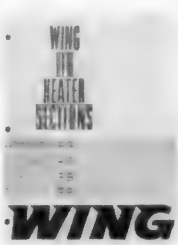
Circle **Item 10** on Inquiry Card



Split-Case Centrifugal Pumps

Eight-page Bulletin 105C describes the line of single-stage, double suction, horizontal split case pumps manufactured by Aurora Pump Div., The New York Air Brake Co., Aurora, Ill. Contains photos, charts, dimensions, specifications and special features.

Circle **Item 11** on Inquiry Card



Heater Sections

Heater sections for air conditioning preheat, fresh air supply, and process and drying applications, are described in 12-page Bulletin IFB-61, by L. J. Wing Mfg. Co., Linden, N. J. Explains how thermostatically controlled dampers regulate air passing over coils.

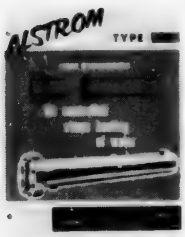
Circle **Item 12** on Inquiry Card

Use the prepaid yellow postcard in the back of the magazine for securing your copies of these catalogs.

Class I and II Fans

The complete line of Sirocco fans, Series 81, Class I and II, is described in 48-page Bulletin A1401, offered by American Standard Industrial Div., Detroit, Mich. Discusses construction features, drives, control methods, and component features. Capacity tables are provided.

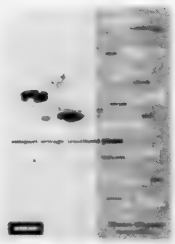
Circle **Item 13** on Inquiry Card



Heat Exchangers

A 31-page catalog available from The Alstrom Corp., New York, N. Y., describes "AX" heat exchangers for controlled steam heating of water. Design and construction features are discussed and engineering data are listed. Selection tables are included.

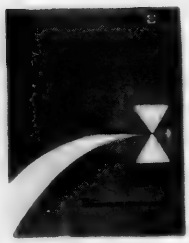
Circle **Item 14** on Inquiry Card



Sewage Treatment Plants

A 12-page brochure, Bulletin 7330, issued by Dorr-Oliver, Inc., Stamford, Conn., describes its new series of compact sewage treatment plants for housing developments, industrial plants, and light construction market where municipal treatment is unavailable.

Circle **Item 15** on Inquiry Card



Controlled Feeding

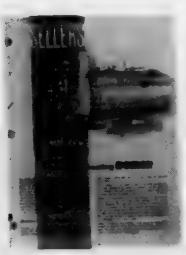
An 8-page bulletin on feeding, weighing, blending, and proportioning equipment, for the controlled feeding of liquids and solids in process industries, is announced by B-I-F Industries, Providence, R. I. Contains descriptions, photos, and schematics.

Circle **Item 16** on Inquiry Card

A-C Motors

Full color Bulletin B-2515, published by Reliance Electric & Engineering Co., Cleveland, Ohio, shows and describes its complete line of a-c motors from 1 to 2000 hp. Product features of each motor are clearly outlined for easy selection of the right motor.

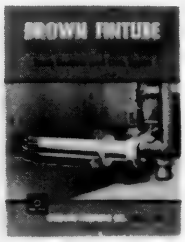
Circle **Item 17** on Inquiry Card



Hot Water Heating Boilers

This 4-page brochure illustrates and describes all features of Model 15 Commodore immersion hot water heating boilers produced by Sellers Engineering Co., Chicago, Ill. Discusses benefits of immersion firing, advantages of the Commodore design, and construction features.

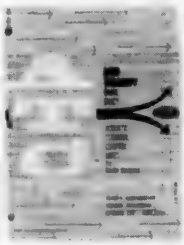
Circle **Item 18** on Inquiry Card



Fuel Oil Heaters

The improved line of fuel oil heaters produced by Brown Fintube Co., Elyria, Ohio, is the subject of 8-page Bulletin 200. Contains technical data on fuel oil heaters, pressure-temperature ratings, heater lengths and sizes, tables of dimensions, drawings and more.

Circle **Item 19** on Inquiry Card



Acoustic Terminal Control Units

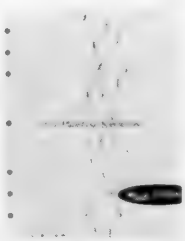
A wealth of information on its low-velocity dual-duct acoustic terminal control units is presented in 12-page Catalog 1361 by Carnes Corp., Verona, Wis. Catalog answers many questions as to the desirability of using these units over a multi-zone or reheat system.

Circle **Item 20** on Inquiry Card

Tankless Water Pressure System

How the tankless Accupressure system maintains constant water pressure in hotel, apartment, or commercial buildings, is told in Bulletin 08C9989 offered by Allis-Chalmers, Milwaukee, Wis. The 4-page bulletin also discusses other applications of this system.

Circle **Item 21** on Inquiry Card



Plumbing Products

This 26-page two-color catalog describes the complete line of plumbing products manufactured by Reed-Cromex Corp., Cleveland, Ohio. Includes such items as lavatory legs, towel bars, utility showers, temperature and pressure relief valves, and many other allied items.

Circle **Item 22** on Inquiry Card

Gasoline Powered Boring Unit

This 6-page bulletin illustrates and describes the G-160, a gasoline powered boring unit offered by Kwik-Mix, Port Washington, Wis. A capacity chart is presented and many of the machine's features are discussed in detail. Includes a list of suggested applications.

Circle **Item 23** on Inquiry Card

Damper Hardware

Damper hardware for all air conditioning systems is discussed in a 4-page color catalog offered by Young Regulator Co., Cleveland, Ohio. Literature shows complete damper hardware installation, and chart for sizing damper blade depths before blades are formed.

Circle **Item 24** on Inquiry Card

Use the prepaid yellow postcard in the back of the magazine for securing your copies of these catalogs.

Heat Transfer Panels

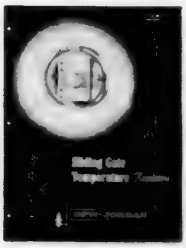
Valuable information on heating, cooling, and air conditioning is included in this 26-page bulletin describing Panelcoil, a heat transfer surface manufactured by Dean Products, Inc., Brooklyn, N. Y. Bulletin 356 includes sketches, tables, graphs, and problem solvers.

Circle **Item 25** on Inquiry Card

Flexible Metal Hose Connectors

Four-page Bulletin 26, available from Atlantic Metal Hose Co., New York, N. Y., describes flexible metal hose connectors. In addition to features and applications, bulletin has sections on stock fittings, specification charts, working pressure correction factors.

Circle **Item 26** on Inquiry Card



Temperature Regulators

Temperature regulators are the subject of 8-page Catalog TCV-1, available from OPW-Jordan, Cincinnati, Ohio. Catalog is fully illustrated and contains complete engineering information and technical data. Includes flow curves, sizing charts and applications.

Circle **Item 27** on Inquiry Card

Acoustic Panels

The Korfund Co., Westbury, N. Y., announces 6-page Bulletin K16D, describing its line of Noiseguard acoustic panels. Reasons for superior sound reduction are given, plus construction specifications, application details, and sound attenuation characteristics.

Circle **Item 28** on Inquiry Card

Electronic Air Cleaner

Trion, Inc., McKees Rocks, Pa., describes features of its Type UMT electronic air cleaner in this 4-page brochure. Included are reasons for air filtration, method of air cleaning, capacities, dimensions, installation features, and other important information.

Circle **Item 29** on Inquiry Card

A-C Pump Motors

Kingston-Conley, Inc., Plainfield, N. J., announces a 6-page bulletin descriptive of its full line of a-c pump motors. Contains selection and specification tables, mounting arrangements, speed-torque curves, principal dimensions, and pictures of a number of special designs.

Circle **Item 30** on Inquiry Card

Aluminum Directional Diffuser

This catalog contains complete data on an all-extruded aluminum directional diffuser manufactured by Waterloo Register Co., Inc., Waterloo, Iowa. Shows frame styles and core patterns which are available and gives detailed installation and selection information.

Circle **Item 31** on Inquiry Card

Direct-Fired Gas Heaters

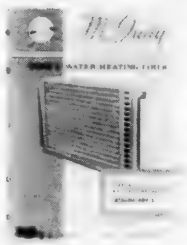
Industrial applications of direct-fired gas heaters are discussed in an 8-page handbook, GN-200, by Reznor Mfg. Co., Mercer, Pa. Publication discusses general and special space heating, make-up air tempering, and combination heating-cooling systems.

Circle **Item 32** on Inquiry Card

Roof Fan

Four-page Bulletin 226, published by Stamford Fan Co., Stamford, Conn., describes its Cyclone roof fan. Complete data for various models are listed, including size, rpm, fan tip speed, horsepower requirements, dimensions, static pressure and needed information.

Circle **Item 33** on Inquiry Card



Heating Coils

Catalog 404-2, covering the Type "5" coil, is issued by McQuay, Inc., Minneapolis, Minn. Contains direct selection tables for simplified, time-saving coil selection, in addition to general information on air and water. Includes heat transfer data, and application recommendations.

Circle **Item 34** on Inquiry Card

Centrifugal Pumps

Bulletin 722.6, available from Goulds Pumps, Inc., Seneca Falls, N. Y., describes two new sizes in its Model 3305-06 2-stage centrifugal pump line. Information includes performance curves, material specifications, interchangeability charts and dimensions.

Circle **Item 35** on Inquiry Card

Slip Type Expansion Joints

Royalton Co., Inc., Gasport, N. Y., announces Bulletin 259 describing its slip type expansion joints for absorbing pipe line thermal expansion. Construction, models, and dimensions are covered, as well as engineering data on thermal expansion and thrust on anchors.

Circle **Item 36** on Inquiry Card

NEWS OF EQUIPMENT AND MATERIALS

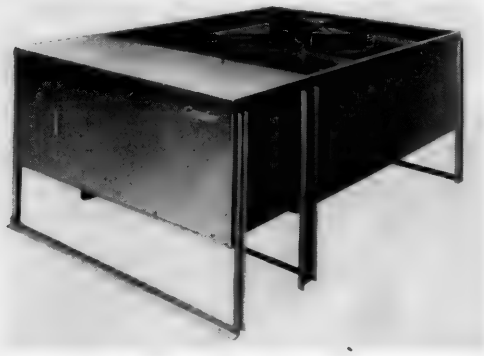
Use the convenient prepaid yellow postcard in the back of the magazine for securing more information about new equipment and materials described in this department.

10-Ton Condensing Unit

A 10-ton condensing unit, introduced by Carrier Air Conditioning Co., Syracuse, N. Y., has capacity control as standard equipment and is especially designed for rooftop installation.

Weighing only 870 lb, the unit stands 20⅞ inches high without legs, which adjust to 12 or 18-inch heights. The vertical discharge propeller type fans make possible the low silhouette, low operating costs and eliminate need for wind deflectors.

Controls automatically unload two cylinders to



give two-thirds capacity, delivering efficient cooling and humidity control under light loads. Time Guard control circuit prevents rapid cycling of the compresor and reduces starting load on the electric system.

Compressor and controls are in a separate compartment so that the unit can be serviced in operation without danger from the fans, which are also shielded by closely spaced wire guards.

More Information? Circle Item 37 on Inquiry Card.

Capped and Certified Tubing

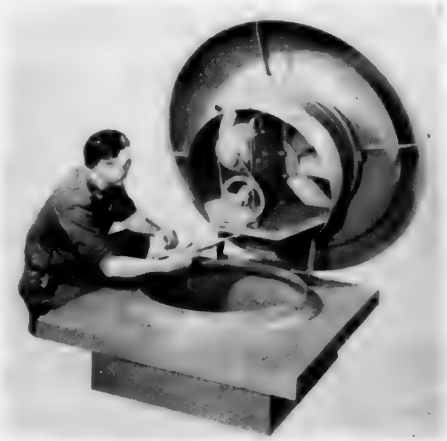
Capped-and-certified restrictor tubing is announced by Kensico Tube Co. Div., Mt. Kisco, N.Y., with the certification covering 100% testing of tubing to meet flow specifications.

After testing, lengths of certified tubing are capped at both ends with a heat-sealed plastic. The factory capping saves a sealing operation by the equipment manufacturer in the sub-assembly stage, while the certification replaces the individual testing by the manufacturer. The tubing is produced in sizes from a minimum of .072-inch OD by .026-inch ID to a maximum of .172-inch OD by .115-inch ID.

More Information? Circle Item 38 on Inquiry Card.

Ventilator Has "Flip-Top" Housing

In order to make motor, drive assembly, and fan easily accessible at a convenient working height above roof level, DeBothezat Fans Div., American Machine and Metals, Inc., East Moline, Ill., has developed a roof ventilator with a housing that flips back 90 degrees.

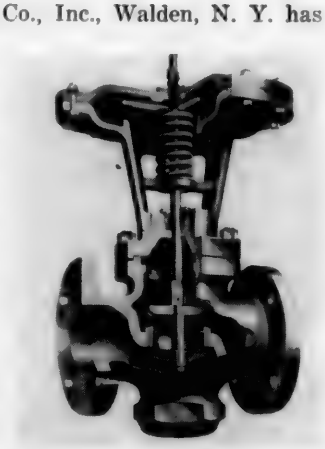


The ventilator is available with fan wheels from 12 to 48 inches in diameter and with capacities up to 43,070 cfm. Also available is a vertical discharge model that exhausts dust and oil-laden air at high velocity, dispersing contaminants high enough to prevent their re-entry into the building's air supply.

More Information? Circle Item 39 on Inquiry Card.

Valve Increases Control Accuracy

Spence Engineering Co., Inc., Walden, N. Y. has developed a valve for fast, accurate temperature control at very low pressure differentials. Designed for heat exchangers served by steam at pressures of 15 psi or less, the Type G2 main valve controls at practically zero pressure drop.

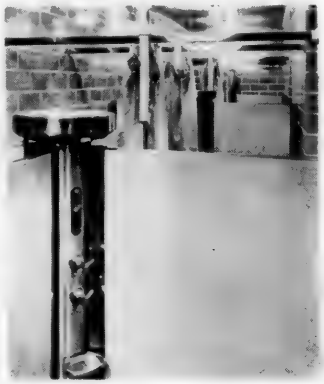


The single-seated valve is available in sizes from 2 to 8 inches with 125 lb flanges; double-seat in sizes 10 to 12 inches. Stainless steel seats are standard on the valve to provide the greatest resistance to the action of wet steam.

More Information? Circle Item 40 on Inquiry Card.

Four and Six-Person Column Shower

A four- and six-person column shower for schools, institutions, industrial plants, recreational facilities, and other buildings is offered by Bradley Washfountain Co., Milwaukee, Wis.



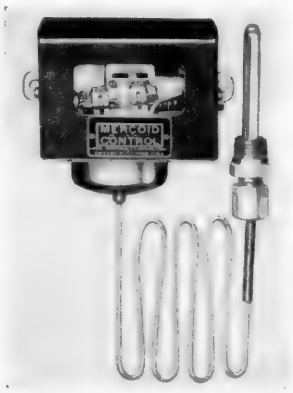
Savings in floor space, economy of water use, and reduction of installation costs are possible because either four or six persons may shower with just one set of piping connections. Only three plumbing connections are required for each shower unit (two supplies and one drain).

Three heights, 5, 5½, and 6 ft, are available for each of the new shower columns. Partitions are also available for both the four- and six-person showers, although receptors are not. Standard equipment includes shower heads, control valves, soap trays, a cover for the top of the column, and stainless steel drain flanges.

More Information? Circle Item 41 on Inquiry Card.

Lightweight Temperature Control

A temperature control, type AT-153, for applications involving air conditioning, freeze protection, refrigeration, and various industrial applications, is made available by The Mercoid Corp., Chicago, Ill.



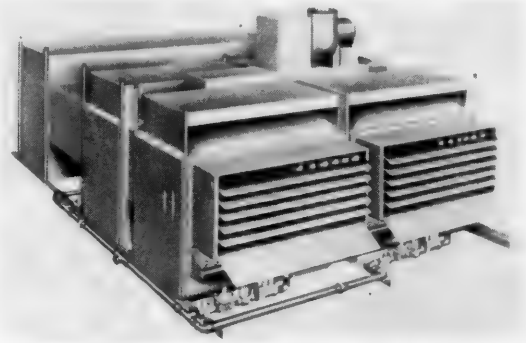
Features include external adjustment, repetitive trip point, visible calibrated dial with pointer, and visible on/off hermetically sealed mercury contact. Operating range (adjustable) 15 to 55 deg F. Differential (fixed) 2½ deg. Control rated at 4 amp. 115 volts, 2 amp. 230 volts a-c or d-c. Provides any of the following operations. Single pole, cut in high (close on rise), single pole, cut in low (open on rise), or single pole, double throw operation.

More Information? Circle Item 42 on Inquiry Card.

Gas Fired Heater Assembly

A new direct-fired gas heater assembly for applications in heating, heating and cooling, partial fresh air and total make up air, processing, and similar systems is made available by Reznor Mfg. Co., Mercer, Pa.

Designated the PAK series, the unit consists of a factory assembly of from one to four duct furnaces together with complementary packaged blowers, mechanical flue exhauster, and control system to provide a complete packaged unit. Four models are available, ranging in capacity from 200,000 Btu to 1,400,000 Btu input, and assembled in either push-through or pull-through arrangement.



All components are rigidly bolted to heavy angle iron bases, forming a single installation unit that frees the designer from detailing an efficient, coordinated assembly of heater, blower, and accessories. Possibility of improper field assembly is removed, as well as the necessity for costing both components and assembly labor.

More Information? Circle Item 43 on Inquiry Card.

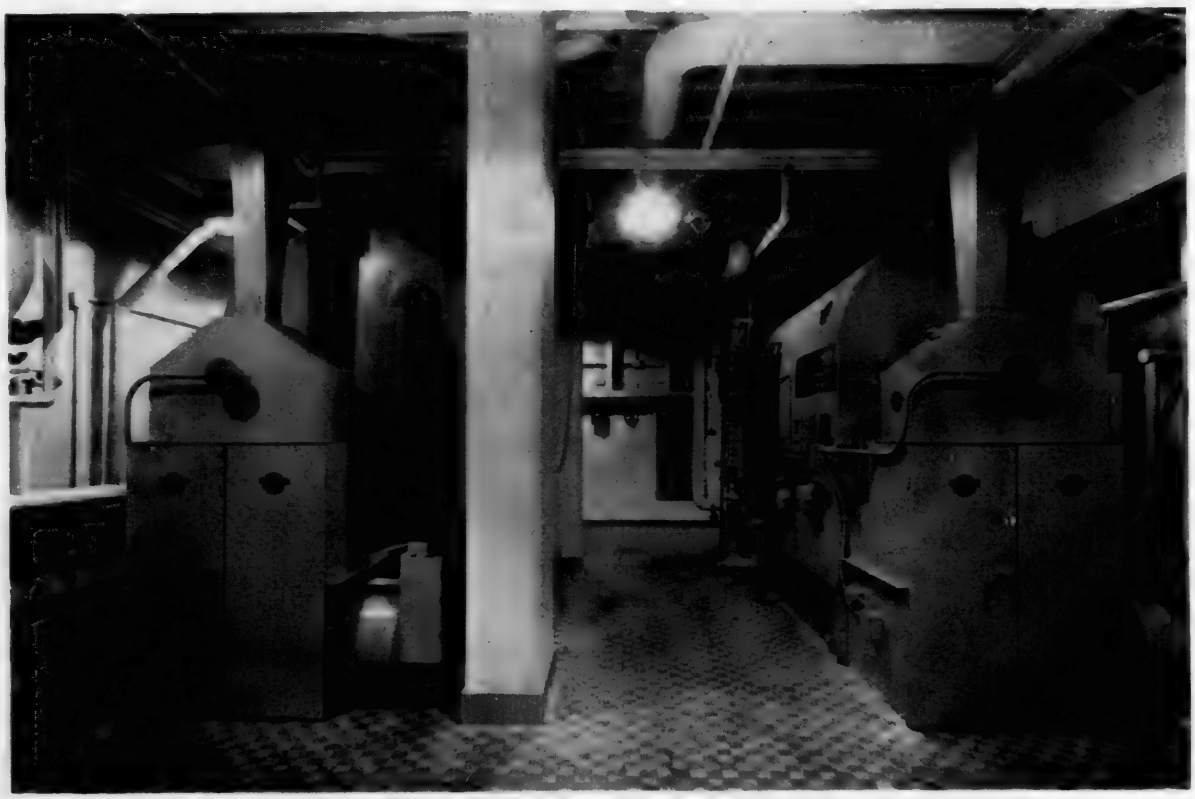
Gas-Fired Air Make-Up Units

Aerovent Fan Co., Inc., Piqua, Ohio, introduces its new gas-fired industrial air make-up units, which it claims are the answer to fluctuating temperatures and negative pressures resulting when ventilating systems are operated without sufficient air.

Two basic designs, each manufactured for use with natural, mixed, or propane gases, permit operation in any type or size structure. Units are belt driven, equipped with improved airflow burners. Standard units are furnished in sizes 27 to 60 inches for capacities to 50,000 cfm and heat releases to 4,875,000 Btu per hr. Other units in sizes to 84 inches for capacities to 100,000 cfm and heat releases to 10,000,000 Btu per hr supplied to customer specification.

More Information? Circle Item 44 on Inquiry Card.

Packaged, Coal-Fired Boiler Announced; Industrial, Commercial and School Uses Seen



Clean, compact boiler room of the Coal Building, Washington, D. C., boasts two 71-hp IBW Coal-Pak automatic low-pressure steam generators, developed by Bituminous Coal Research, Inc. Front view of the two boilers shows the pulsating-grate Canton Powr-Matic stokers. These Powr-Matic units supply steam for both heating and air conditioning.

After three years of research and development, Canton Stoker Corp., Canton, Ohio, has begun marketing a packaged coal-fired boiler for industrial, commercial and school use. The company feels that the new product will help regain much of the market coal has lost to competitive fuels in the steam generation field.

The Powr-Matic unit combines boiler, stoker, combustion control system, coal conveyor and ash conveyor . . . all completely automatic. Canton Stoker buys the boiler and some components. It makes the stoker, conveyors and parts of the control system. The boiler is "packaged" at the Canton, Ohio, factory.

At the suggestion of a bin level control, coal is picked up automatically in the coal bin and transferred to a small storage hopper at the front of the boiler. There it rests until the controls attached to the steam or hot water lines signal the stoker mechanism to start and feed more fuel.

When boiler needs are met, the electronic controls respond immediately. The equipment slows down and then stands by until more fuel is needed. Turbulent jet firing inside the furnace insures smokeless combustion and thorough use of combustibles in the fuel.

At the rear of the furnace, ash is dribbled into enclosed container or conveyed outside the building if desired.

The unit can be operated at 10 to 100% of capacity, thus preventing overheating and waste of fuel. Combined with a converter, it can air condition a building in the summer. The unit can be wired so additional units may be cut into the circuit when weather conditions or steam demand requires such action.

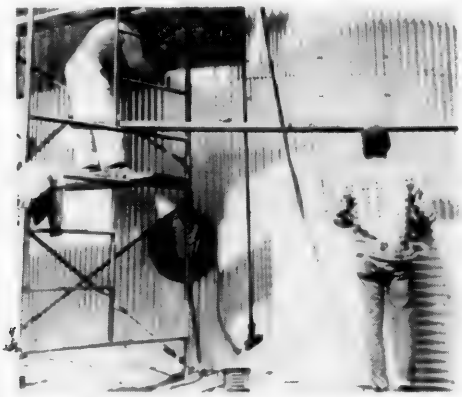
Any number of units may be operated in tanden in a plant. Six sizes from 70 to 300 hp are being made available on a regular, lease or time purchase plan by the manufacturer.

More Information? Circle Item 45 on Inquiry Card.

Metal-Faced Sheet Insulation

An insulation system developed by Johns-Manville, New York, N.Y., combines an efficient insulation material with a diamond-rib sheet aluminum facing. Called Speed-Insul panels, the system offers a time and labor saving method of applying sheet insulation in locations where a weather-resistant facing is required, such as on outdoor tanks.

The panels consist of Spintex insulation, factory assembled with an aluminum facing. It is supplied in sheets about 50-inches wide by 100-inches long,



and is designed to provide a net insulation coverage of 4 x 8 ft, when applied with recommended overlap. Panels are fastened to metal surfaces using threaded studs welded to the surface to be insulated.

More Information? Circle Item 46 on Inquiry Card.

Industrial Ball Valve

W-K-M Div., ACF Industries, Inc., Houston, Tex., has developed an industrial ball valve which it believes will provide industry with a universal ball valve that can be manufactured in a broad range of sizes for the greatest possible number of uses.

The new valve, called Con-O-Sphere, features a sealing capsule of conical-shaped Teflon, which is molded around the ball that controls the on-off action of the valve. The Teflon capsule and a screw-in base plate are the chief reasons why the valve is called one of the most easily adjusted, maintained, and overhauled valves available to industry. All adjustments are made merely by tightening the base plate. The Teflon, a resin that is impervious to most materials, cold flows toward the area of least resistance.

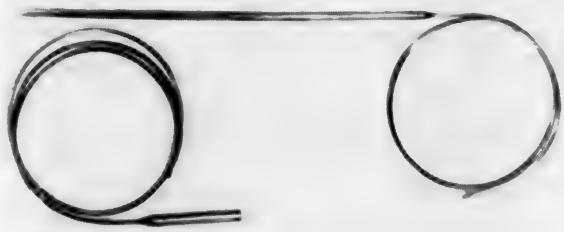
The valve is now manufactured in sizes from ⅛ to 2 inches and in a working pressure range from vacuum to 1440 psi. It is available in a number of metals including ductile iron, carbon steel, bronze, aluminum, and several stainless steel alloys.

More Information? Circle Item 47 on Inquiry Card.

One-Piece Capillary Tube and Bulb

One-piece construction of a capillary tube and bulb assembly, in sizes for all types of instrumentation and control systems, is offered by Kensico Tube Co. Div., Mt. Kisco, N.Y.

The one-piece assembly for thermosensing elements is made to specifications but the range offered in-



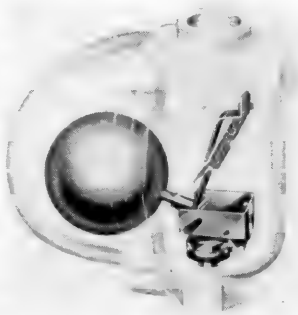
cludes bulk sizes up to ⅜-inch OD maximum, by any desired length, and with the capillary tubing down to a minimum of .010-inch ID.

The design as a single piece saves a joining operation in the assembly of instrumentation systems and gives the added efficiency of joint free flow.

More Information? Circle Item 48 on Inquiry Card.

Float Thermostatic Steam Trap

A new float thermostatic steam trap, which provides continuous discharge of condensate and air, is available from Farris Engineering Corp., Palisades Park, N. J., manufacturer of safety and relief valves.



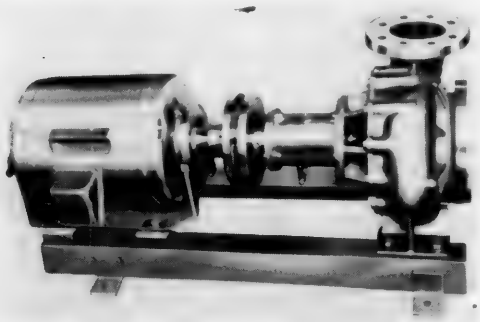
A rocker design, which simplifies mechanical linkage, allows greater compactness. There are no pivots to wear or cause trap to stick. The ball as well as all working parts are made from high quality stainless steel. In-line inspection is accomplished simply by removing body housing.

Applications for this new steam trap include: Unit heaters, steam main drips for terminal ends and branch mains, large boiling pans and steam tables, heat exchangers, instantaneous heaters, cylinder dryers, stills and autoclaves, and vulcanizing presses. Connections are ¾-inch American Standard pipe threads. Pressure ranges are from 0 to 30 psi; 0 to 75 psi and 0 to 150 psi.

More Information? Circle Item 49 on Inquiry Card.

Centrifugal Pump Added

Dunham-Bush Inc., West Hartford, Conn., announces an addition to its line of in-line circulators and A5 and A9 close coupled centrifugal pumps. The new centrifugal pump, known as the B9, features sleeve bearing forced feed lubrication for long bearing life and a self aligning coupling that connects sleeve bearing motor to pump. This arrangement



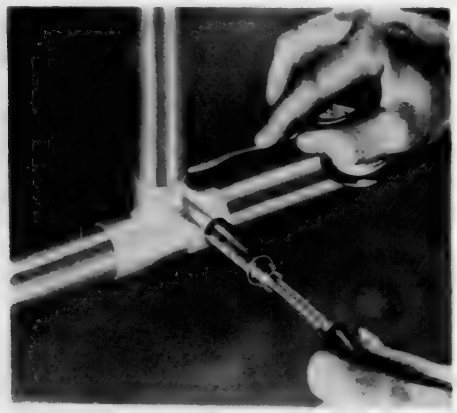
eliminates the necessity of on-job realignment and considerably lengthens coupling and bearing life.

Other features include: Fabricated angle iron base for quieter operation and easy cleaning access in and around pump; 1750 rpm sleeve bearing motor; capacity up to 1,000 gpm; heads to 80 ft.

More Information? Circle Item 50 on Inquiry Card.

Tinned, Prefluxed Copper Fittings

Nibco, Inc., Elkhart, Ind., has begun production of cast bronze and wrot copper fittings that are chemically cleaned of oxidizing elements, protected with a micro-thin coating of tin, and prefluxed before they ever leave the plant. The new line of Color-



Guard fittings makes it possible to install copper plumbing systems better, faster, and at lower cost than ever before.

In addition to acting as a barrier to prevent copper from oxidizing, the micro-coating of tin promotes capillary action to improve the solder flow and insure a proper bond. It also increases the tensile strength of cast fitting joints by 30%, making cast joints as strong as wrot, according to the manufacturer. The fittings can be stored indefinitely under normal conditions and still insure bonding without additional cleaning or fluxing since the rosin flux has an indefinite life.

More Information? Circle Item 51 on Inquiry Card.

Head Pressure Control Valve

The Trane Co., La Crosse, Wis., has developed a head pressure control valve to improve the cold weather performance of its air-cooled condensers and refrigeration units.

Low entering air temperatures result in lowered condensing head pressure which can hinder proper thermal expansion valve feeding and operation. This new control valve, called the Trane Unipressure Controller, maintains the condenser and receiver pressure at the valve setting through a principle known as hot gas by-pass. Condensing capacity is modulated by flooding part of the condensing surface with liquid refrigerant. When head pressure falls, the valve permits some of the discharge gas from the compressor to bypass the condenser and enter the condenser outlet line and receiver. This restricts the drainage of refrigerant from the condenser, flooding it to maintain constant condenser and receiver pressures.

Other features include fully automatic control; easy installation; no electric or pneumatic power required; explosion proof; and proper functioning in any position.

More Information? Circle Item 52 on Inquiry Card.

Cloth Resists High Temperatures

A vinyl coated glass cloth for high temperature applications in the industrial and maintenance field is being marketed by Reeves Brothers, Inc., New York, N. Y. The cloth, which comes in 36 and 50-inch widths, is specially developed and treated for fire resistance and flexibility.

More Information? Circle Item 53 on Inquiry Card.

How Empire State Building and American Airlines solved vital fire protection problems with EVERLASTING VALVES

102 stories, 1,472 feet high, 16,000 tenants and 35,000 visitors sum up the fire protection problem of the Empire State Building. An in-building fire protection system is necessary to an unfailing water supply.

American Airlines loading bridge, shown below, gives passengers positive protection against fire with a unique deluge system.

Both these fire protection systems depend on Everlasting Pendulum Stop Valves, which have been installed in thousands of critical fire protection systems over the past 35 years.

For complete information on the unique American Airlines and Empire State Building systems, write for bulletins F. They include an editorial description of both these installations and a bulletin describing Everlasting's positive action pendulum stop valves.

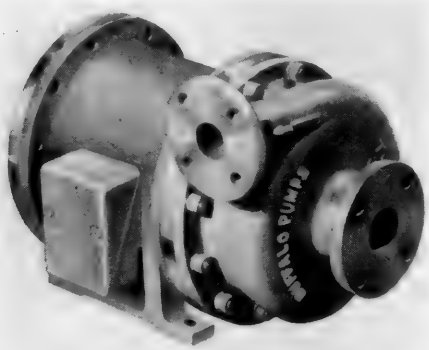
Everlasting also makes a line of quick-opening valves for general service, boiler blow-off, and handling viscous materials, as well as a line of cylinder-operated valves. Bulletins on all these valves are available. **Everlasting Valve Company, 75 Fisk Street, Jersey City 5, New Jersey.**

EV 410

Leakproof Hermetic Pumps

Buffalo Pumps Div., Buffalo Forge Co., Buffalo, N.Y., has developed a new line of centrifugal pumps, totally enclosed and hermetically sealed for use with toxic, inflammable, or highly volatile liquids.

Simplified design includes a new, long-life, self-adjusting bearing. Mechanical seals and stuffing boxes are eliminated. Positive protection is provided against leakage of expensive or noxious liquids.



These single suction pumps with enclosed, hydraulically balanced impellers are ideal for transferring liquids in the chemical, petro-chemical, atomic energy, marine, and other industries.

New line at present will include thirteen sizes, with discharges ranging from 1 to 5 inches. Standard units are designed for 120 psig and temperatures of 40 deg F. through 250 deg. Special models are available for higher pressures and temperatures.

More Information? Circle Item 54 on Inquiry Card.

Insulation of Ducts Simplified

A duct insulation which is strong, light, and easily handled and applied has been developed by York Insulation Co., Hillside, N. J. It consists of a fiber glass blanket laminated to a sheet of kraft, faced with aluminum foil, and reinforced with fiber glass yarns across its length and width.

Since it prevents condensation, maintains cold air temperatures, and protects against heat loss, the insulation is ideal for use on summer cooling and winter heating systems.

More Information? Circle Item 55 on Inquiry Card.

Unit Desalts or Purifies Water

A saline water conversion unit, which utilizes an electrodialysis process to remove salts or impurities from brackish water, is commercially available from Aqua-Chem, Inc., Waukesha, Wis. It employs special membranes which selectively block or permit the passage of ionized salt particles.

Two models have been developed. One is designed for saline water desalting and has applications in hotels, municipalities, institutions, and other buildings needing abundant daily supplies of fresh water. The other model is designed for chemical applications for the recovery or concentration of valuable chemicals from solutions. Typical applications include paper, plastics, chemical, dairy, and food and beverage processors.

Both units have flow rate capacities of 5700 gal a day or 3.96 gpm if short runs are desired. The over-all dimensions, including stack and mounting frame, are 36 x 68 x 24 inches and the electric control panel measures 24 x 36 x 8 inches.

More Information? Circle Item 56 on Inquiry Card.

Castable Has Low Gunning Rebound

A high-strength castable refractory has been developed by The Babcock & Wilcox Co., Refractories Div., New York, N. Y., for pneumatic gun placement with low rebound loss and minimum dusting. Placed by wet or dry gun methods, the B&W Kaogun-HS castable produces a high strength monolithic body with outstanding abrasion resistance and excellent resistance to thermal shock.

The new refractory has a recommended use temperature of 2500 deg F. Gunning applications for which it is suitable include linings for ashpits, stacks, incinerator doors, ash hoppers, flues, boiler furnaces, dust collectors and settling chambers, rocket engine static firing bays, catalyst carrying lines in refining and petrochemical plants, by-pass stacks in CO boilers and seal tanks, and as a rear wall seal on traveling-grate furnaces.

A high-alumina cement provides an exceptionally strong hydraulic bond for the castable, which has a highly calcined, carefully graded base. It has demonstrated excellent strength and dimensional stability throughout its use temperature range. Resistance to abrasion is exceptionally high.

More Information? Circle Item 57 on Inquiry Card.

"Here's why I'm sticking with H&M air-cooled condensers

. . . H&M's Limitrol valve lets you use them year-round!"

"Many of my air conditioning and refrigeration systems have to operate 12 months a year. But cold weather used to raise cain with compressor-condenser balance.

"Then I learned that Halstead & Mitchell had a Limitrol pressure modulating valve that adjusts their air-cooled condenser capacity to compressor head pressure, whatever the outside temperature. What's more, H&M gives me multiple circuiting at no extra cost!"

You'd do well, too, to standardize on H&M Air-Cooled Condensers. There are propeller fan models with vertical or horizontal air discharge, and centrifugal fan models for inside installation with ductwork. Capacities of 5 to 100 tons.

Want more information? Call your parts wholesaler or write for Bulletin B-10. Halstead & Mitchell Co., Bessemer Building, Pittsburgh 22, Pa.

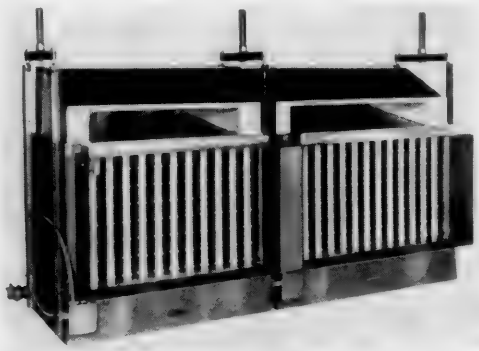
Air-Cooled Condensers • Air Handlers and Coils • Cooling Towers • Water-Cooled Condensers
Export Representatives: Sabal-Kielman, Inc., 15 William St., New York 5, N. Y.

HM
Halstead & Mitchell

Gas Duct Furnaces

Hastings Air Control, Inc., Omaha, Neb., introduces its gas duct furnaces with A.G.A. approval for installation downstream of refrigeration coils. The units have low air pressure drop and are designed for use with air conditioning systems where by-pass ducts would be too expensive.

A stainless steel condensate shield diverts moisture, formed inside the exchanger tubes in summer, from



the pilot, thermocouple, and ignition slots, and into an aluminized steel bottom pan with threaded drain connections.

The furnaces are available in 7 sizes from 75,000 to 300,000 Btu per hr, and may be close-coupled to any total capacity. Optional accessories include modulating and two-stage gas valves, dual-fuel controls, electric ignition, adjustable air by-pass sections, enclosed blower sections, high-velocity nozzles, and high-pressure regulators.

More Information? Circle Item 58 on Inquiry Card.

Aluminum-Vulcanized Rubber

Aluminum sheet and foil now can be vulcanized onto rubber, yielding a material combining the surface toughness, corrosion resistance and insulative values of aluminum with the flexibility of rubber, according to Reynolds Metals Co., Richmond, Va.

Projected applications for the aluminum-vulcanized rubber include aluminum tire cords for longer wear, flexible aluminum-covered pipe and tubing, tenting and tarpaulins.

Reynolds applies the coating to the metal and ships it to customers in roll form. When the rubber is vulcanized, the aluminum becomes an integral part, as difficult to remove as the tread on an automobile tire. The exposed aluminum surface can be attractively decorated with color, printing, or embossing.

More Information? Circle Item 59 on Inquiry Card.

Boiler Sludge Minimized

A family of organic dispersives formulated to minimize adherent sludge formation in boilers and recirculating cooling systems is offered by Hagan Chemicals & Controls, Inc., Pittsburgh, Pa.

The dispersives are dry powders blended to cover a wide range of dispersing properties. Selection of a dispersive is based on both physical and chemical examinations of deposits.

More Information? Circle Item 60 on Inquiry Card.

Adjustable Float Valve

A float valve that operates on a single pivot principle for trouble-free operation is announced by Skuttle Mfg. Co., Milford, Mich.

The valve is simplified to the point that there are no moving parts. The all rubber heavy-duty valve seat is adjustable and can be reversed. The design of the valve seat enables it to act as a splash shield.

Another feature is the chrome-plated valve jet that assures positive shut-off.

The manufacturer states that this valve and glass float assembly is well suited for many water level control applications.

More Information? Circle Item 61 on Inquiry Card.

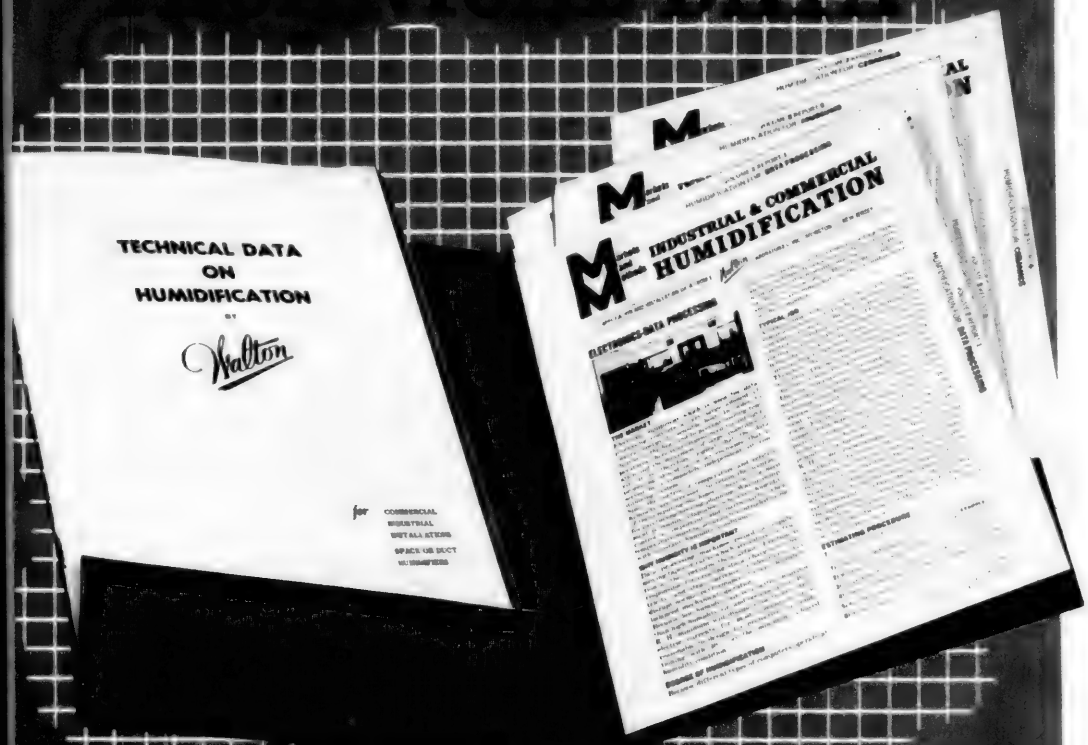
Algae, Fungus Inhibitor Developed

An algaecide formulation, D-130, composed of a mixture of chlorinated phenolic compounds, kills off existing growth and prevents new growths. It was developed for use in non-potable water systems by Bird Archer Co., Philadelphia, Pa.

Used in cooling towers, air conditioning systems, ammonia condensers, and industrial water spray ponds, the formulation may be added at different feed rates to cope with light or heavy infestation, or to prevent the appearance of new organisms.

More Information? Circle Item 62 on Inquiry Card.

Now... A Gold Mine of TECHNICAL DATA



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BREWERIES
CABINET MAKING
CANDY
CARPET
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CELLOPHANE
CERAMICS
CEREALS
CIGARETTES
CIGARS
CONTAINERS (PAPER)
CORDAGE
COTTON
DECALS
EGG STORAGE
ELASTIC YARNS
ELECTRONIC COMPUTERS
ENVIROMTL. CHAMBERS
FILM PROCESSING
FILM STORAGE
FLORISTS
FOOD STORAGE
FRUIT STORAGE
FURNITURE
GLASS (LENSES)
GLOVES
GLUING
GREENHOUSES
HATCHERIES
HATS (FUR FELT)
HORTICULTURE
HOSIERY
HOSPITALS
INCUBATORS
KNITTING
LABELS
LABORATORIES
LACE
LEATHER
LETTER PRESS
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MEATS
MULLERS
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completely self-contained air conditioning units

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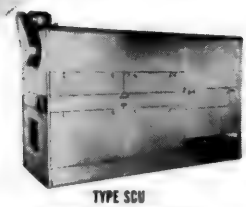
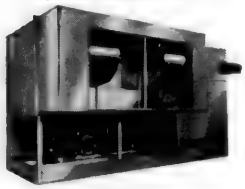
. . . began the manufacture of the first completely self-contained commercial type air conditioning units in 1937. Development has been continuous since that time, and Governair now manufactures packaged air conditioning units, for both commercial and industrial application, in the widest range of capacities available in the industry.

Governair Corporation also constantly recognizes the importance of producing a high quality, completely flexible system to benefit the end user best. Production facilities are tailored to accomplish these ends economically. This, in turn, makes the Governair prices highly competitive, even though only the finest components are used in the assembly.

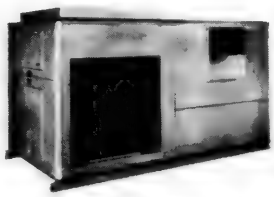
Development of the larger tonnage units has made available the economy of installation and reliability of a factory balanced and tested package system . . . for even the largest industrial requirements. Single units of 120 ton capacity are being fabricated regularly — and to the exact specifications of the customer.



TYPE SCU
Evaporative Condenser Model

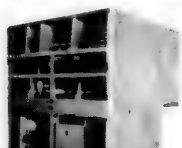


TYPE SCMZ
Complete Multi-Zone Package



TYPE SCAC
Air Cooled Condenser

TYPE ST
Water Cooled Model



TYPE STMZ
Water Cooled Multi-Zone

GOVERNAIR CORPORATION
4840 NORTH SEWELL
OKLAHOMA CITY, OKLAHOMA

GOVERNAIR

Write for detailed information, or consult your yellow page directory for the name of our local representative.

Air Washer Resists Deterioration

A new air washer-evaporative cooler that cleanses, humidifies, and cools incoming air is now being fabricated of rigid polyvinyl chloride by S & C Mfg. Co., Cincinnati, Ohio. This light-weight construction reduces the weight approximately ⅔ that of units made from conventional materials, the manufacturer claims. In addition to its light weight, the air washer will not rot, rust, corrode, or support combustion, a decided advantage over washers made of metal or wood.

Cleaning and purifying of incoming air is accomplished by a spray-mist action which washes contaminants and pollutants from the air, withholding them in a settling tank. A filter strainer filters the recirculating water, thus preventing any possibility of clogged nozzles.

Cooling is by evaporation and occurs when the entering air strikes the spray-filled chamber, resulting in temperature reduction of both air and water. Humidification takes place when dry incoming air takes on moisture as it passes through the spray chamber.

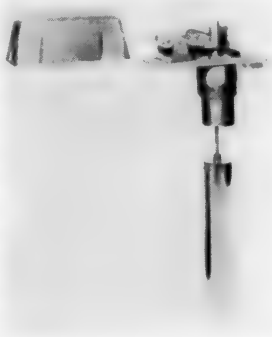
More Information? Circle Item 63 on Inquiry Card.

Liquid Level Indicator

Called an outstanding development in liquid level indication, the Model DLR Modulevel precision level transducer is announced by Magnetrol, Inc., Downers Grove, Ill. The new transducer is used to measure liquid level and convert it directly to an electrical resistance. It is designed for general industrial use and fulfills the need for an inexpensive electrical level-sensing device for measuring liquid level in open or pressure vessels.

This model utilizes a unique frictionless magnetic coupling to transmit motion from level changes in the vessel to contact wiper movement on the potentiometer winding inside the instrument housing.

Primary level change is sensed by a range displacer suspended in the liquid by means of a precision Ni-span-C expansion spring. As the liquid level rises or falls, the effective weight of the displacer changes, causing the spring to extend. A magnet-attracting ball is rigidly attached to the displacer by a stem and remains centered inside a non-magnetic pressure-tight tube due to the downward weight of the displacer. A pivoted horseshoe magnet on the outside of the enclosing tube follows the attraction ball and transmits movement to the contact wiper.



Various length displacers are available as standard to measure a wide range of level travels. An adjustment is provided to calibrate the resistance level transducer for liquid specific gravity variations of 0.7 to 1.1.

The transducer may be used with resistance-type reading instruments for remote level indication, alarm, recording or control or to tie in to computer systems.

More Information? Circle Item 64 on Inquiry Card.

Back Pressure Regulator Valve

The 165 Series, a new line of back pressure regulator valves, is available from OPW-Jordan, Cincinnati, Ohio. The valves are suitable for 250 psi at 500

deg F in ductile iron and bronze bodies, and 300 psi at 600 deg in stainless steel and cast iron bodies.

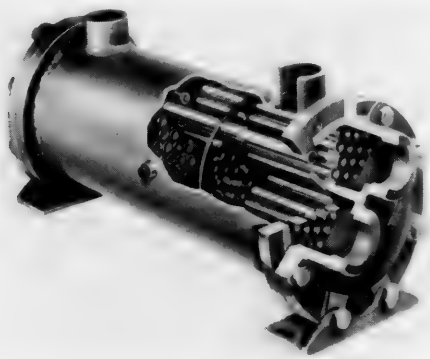
Suitable for steam, water, air, oil, gas, or chemical service, the valves are designed to maintain constant back pressure or to relieve pressure at a given set point. Five control ranges are available from 3 to 170 psi.

More Information? Circle Item 65 on Inquiry Card.

Compact Heat Exchanger

Major advancements in the design, engineering and construction of standardized compact heat exchangers are represented in a new line introduced by Basco, Inc., North Tonawanda, N. Y.

Designated as Type 500, the exchangers are available with shell diameters from 3¼ inches through 8¼ inches and in lengths from 1 ft 4¾ inches through 6 ft 7 inches. Use of ferrous materials for shells, connections and bonnets forms an exceptionally strong and durable structure that withstands pressure surges and the corrosive action of synthetic oils



and hydraulic fluids. Elimination of hubs (commonly used on this type of exchanger) overcomes the problem of leakage resulting from casting porosity and improper soldering or brazing.

The units meet heating and cooling requirements in the engine, compressor, turbine, hydraulic equipment, machine tool, light marine, and process industries where fluid temperatures must be closely controlled with a compact, ruggedly-built exchanger, the company announces.

More Information? Circle Item 66 on Inquiry Card.

Belling Tool Expands Pipes, Tubes

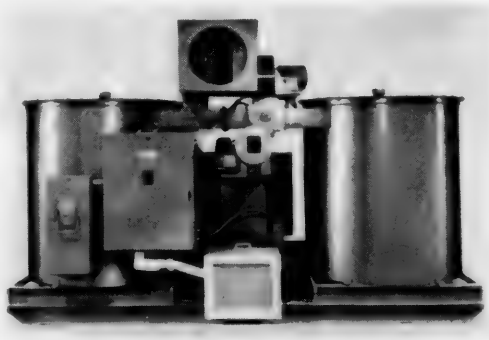
Expanding the end of a pipe or tube to permit the insertion of another pipe or tube of the same original diameter is made easy with a tube belling tool developed by Elliott Co., Jeannette, Pa. Driven by an electric or air motor, the spinning tool permits such accurate and precise expansion, that tubes will join with a snug sliding fit, the firm reports.

Most common application for the belling tool involves tube bundles which require separate return bends that must be soldered or brazed in place. Manufacturers of heat exchangers and similar apparatus for air-conditioning equipment, small heating units, and the like should find ready use for this device in various phases of their production.

More Information? Circle Item 67 on Inquiry Card.

Industrial Dehumidifier Added

Model A500, an adsorption dehumidifier with high capacity adsorption and reactivation and efficient high flow-low flow air transfer valves, is the latest addition to the line of dehumidifiers offered by Universal Dynamics Corp., Alexandria, Va.



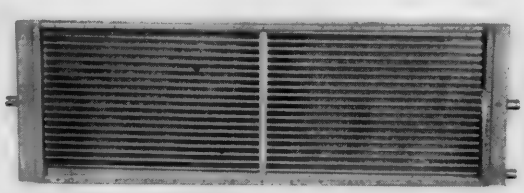
The A500 features plug-in installation and clean design. It handles 3000 cfm and removes up to 75 lb of water hourly. Variations of this model are also being offered for high temperature dehumidification, drying of temperature sensitive products, laboratory dewpoints of minus 100 deg F, and pressurizing systems with bone dry air and gases.

More Information? Circle Item 68 on Inquiry Card.

New Steam Coil Design Introduced

A steam coil design, which supplies steam from both ends of the coil through inner distributing tubes, is featured in the new NFD steam coils manufactured by Bohn Aluminum & Brass Corp., Danville, Ill.

The new design provides an even distribution of steam across the entire coil face. The Equa-Jet



inner tubes are automatically self-centering in the condensing tubes and have their jet orifices facing in the same direction as the steam return allowing for free flow of condensate.

The NFD coils also feature die-formed plate-type aluminum fins in standard lengths from 72 to 144 inches; headers at both ends of coil are heavy-wall seamless copper with die-formed end caps.

More Information? Circle Item 69 on Inquiry Card.

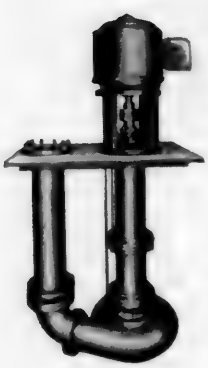
"from Chicago"

A complete line of Vertical Enclosed Shaft Non-Clog Pumps

FOR HEAVY DUTY PUMPING OF SEWAGE, SUMP AND STORM WATER, CONTAINING SOLIDS

Chicago pumps are durably built units featuring micrometer ball bearing adjustment of rotating elements, tongue and groove registering, and oversized bearings. The Chicago two port non-clog impeller remains in natural hydraulic balance thruout the pumping cycle. All impellers are also dynamically balanced.

Manufactured by Chicago Pump, with over 52 years of unequaled experience in the design and manufacturing of non-clog pumps. Backed by a reputation for excellence in design and outstanding service to its thousands of satisfied customers. Write for Bulletin 124-G.



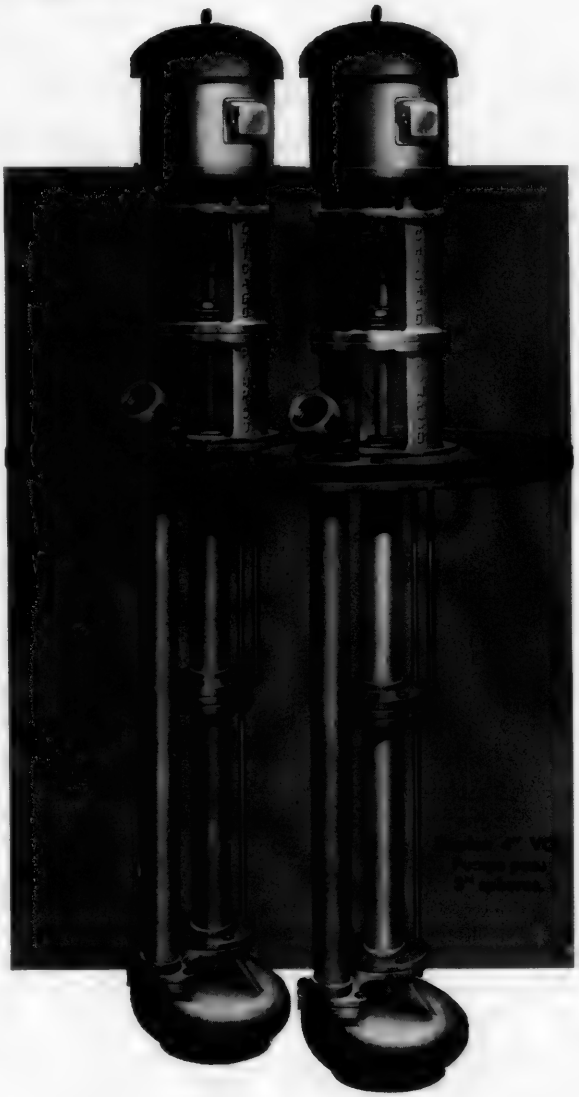
10" VCS Pumps pass 5" spheres.

HIGHER CAPACITY VCS PUMPS

Pumps range from 4" thru 10" discharge size available for single or duplex installation. All pumps incorporate the same high grade materials and machined tolerances for extended life.

EXCLUSIVE SEALTRODE

"Sealtrode", sealed electrode floatless pump controller is a dependable control for any installation. Electrodes cannot become coated or insulated with grease, oil, soap or solids. Elements never corrode as they are sealed from the liquid being pumped.



Capacities: 50 to 5000 GPM
Heads to 105 feet.

fmc CORPORATION

HYDRODYNAMICS DIVISION

CHICAGO PUMP

622J Diversey Parkway • Chicago 14, Illinois

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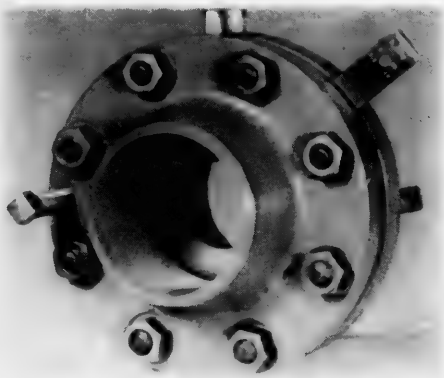
Corner-Tap Orifice

An extremely accurate corner-tap orifice union is manufactured by Robertson Mfg. Corp., Houston, Texas. Designed for use in heating and air conditioning systems, the union is available in pipe sizes from ¼ to 16 inches and can be furnished with welded



neck, slip-on, or threaded connections. All are manufactured from ASTM A181 Gr 1 forged steel for maximum service conditions of 230 psig at 100 deg F.

More Information? Circle Item 70 on Inquiry Card.

High Temperature Plastic Fittings

This new line of injection-molded pipe fittings and flanges of unplasticized polyvinyl dichloride can withstand temperatures as high as 215 deg F, according to its manufacturer, Tube Turns Plastics, Inc., Louisville, Ky. The Geon thermoplastic pipe is expected to be used extensively for process piping handling hot corrosive liquids, for hot water lines and similar applications above the temperature range of regular unplasticized polyvinyl chloride piping.

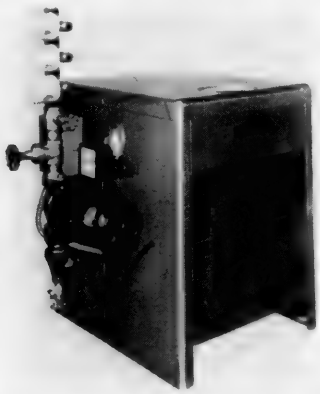
High-impact Schedule 40 and 80 fittings and flanges are available in ½ through 2-inch pipe sizes and will be extended to 4 inches when larger pipe sizes become commercially available. Chemical resistance of Geon pipe and fittings includes handling strong alkalies and acids and many other corrosive liquids. The Schedule 40 pipe safely handles 125 lb pressure at 185 deg F and maintains its high mechanical strength while carrying hot fluids. Geon weighs about one-sixth as much as copper, is self-extinguishing, and has low thermal conductivity.

More Information? Circle Item 71 on Inquiry Card.

Zone Controlled Boilers Available

Continental Mfg. Co., Baltimore, Md., announces that its packaged hydronic boilers, both oil and gas-fired, are now available with zone control.

Fully pre-assembled and wired, the boilers use threaded-type electric zone valves and are completely



adaptable to either iron pipe or sweat copper systems. A single manifold will accommodate up to four zones, and combinations are possible ranging up to eight zones using two manifold assemblies. They may be installed as a supply header off the boiler, as a return header mounted on the circulator flange, or at any other convenient location in the supply or return main. The assemblies are wired from valve to valve, and are complete with properly marked wiring "pigtail" leads to make all necessary connections.

More Information? Circle Item 72 on Inquiry Card.

New Commercial Register Line

A new line of commercial registers featuring individually-pivoted vertical face bars and a horizontal multi-louver valve is introduced by Air Control Products, Inc., Coopersville, Mich. Identified as the 270 Series, the line of registers is designed for use in those commercial applications where an opposed-action valve is not required.

More Information? Circle Item 73 on Inquiry Card.

Architects and Engineers: Robert and Company Associates, Atlanta, Georgia • General Contractor: Blount Brothers, Montgomery, Alabama
Mechanical Contractor: James E. Smith & Sons, Inc., Louisville, Kentucky

New Atlanta Airport Terminal Features
JENN-AIR POWER ROOF EXHAUSTERS

An outstanding example of efficient design is the Atlanta Airport Terminal, recently completed at a cost of $20 million. This busy terminal handles 372 scheduled commercial flights daily and can load and unload 50 planes simultaneously.

Ventilation for the terminal's network of corridors as well as for the main building itself is accomplished by Jenn-Air Power Exhausters and Relief Vents.

Some of the advantageous features of Jenn-Air units:

- **Exclusive U-spring suspension is 44% more effective than rubber isolators in reducing vibration and noise . . . U-springs are guaranteed for life.**
- **Impellers are dynamically and statically balanced, then balanced integrally with motor to reduce noise still further.**
- **Curb cap bolts directly to roof . . . No louvres or penthouse needed.**
- **Leakproof performance is assured by single-unit cover design and one-piece base and curb construction.**
- **Ageless aluminum and stainless steel construction outlasts any building, never needs painting.**

There's a type and size of Jenn-Air Power Exhauster to meet every ventilating requirement. Write for complete-line folder.

JENN-AIR

JENN-AIR leads in functional imagineering

JENN-AIR PRODUCTS COMPANY, INC., 1102 STADIUM DRIVE, INDIANAPOLIS 7, INDIANA

Valve Stuffing Boxes Eliminated

The "O" ring construction of this single seat pressure reducing diaphragm valve eliminates the use of stuffing boxes, thus reducing maintenance to a minimum. The valve, a product of Atlas Valve Co., Newark, N.J., can be used as a simple governor for controlling the delivery pressure of turbine-driven or direct acting pumps. It is especially suitable for small pumps, which require tight closing governors to control the discharge pressure accurately on minimum loads.

Bronze body valves of this type are designed for working pressures to 300 psi up to 500 deg F. Steel body valves are available for 600 psi working pressure. Both valves are recommended for controlling pressure of steam, fuel oil, water, gas or air where tight sealing is required. They can be used also with any type of pilot or 3-way hand control, if compressed air or hydraulic pressure is available for their operation.

More Information? Circle Item 74 on Inquiry Card.

Damper Regulator

Trim-Lok, a damper regulator with integral automatic locking device for close tolerance air balancing in all heating, ventilating, and air conditioning systems, is now being marketed by R.I.N.C.O., Los Angeles, Calif. It is described as a break-through from the old wing nut regulators, which have been in use practically since the beginning of air control systems.

The automatic locking device sets the damper positively. It stays in position until manually reset and will not shake or rattle loose. When changed building conditions warrant a readjustment in the Trim-Lok setting, the adjustment can be made by means of an extension rod and one operator.

More Information? Circle Item 75 on Inquiry Card.

Wrot and Cast Fittings

Phelps Dodge Copper Products Corp., New York, N. Y., has added a complete selection of wrot and cast fittings to its line of tubular products. Low pressure valves will also be included in this expansion of service to the plumbing, heating, air conditioning and refrigeration industries.

The move enables the firm and its authorized wholesalers to offer a complete package of tubes and fittings in the same order, thus saving their tubing customers the inconvenience of going to two sources of supply.

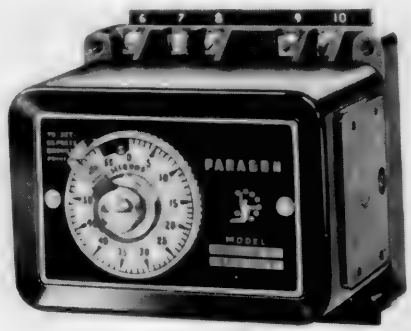
Both the wrot and cast fittings are available in sizes ranging from ⅛-inch to six inches. Factory-clean condition will be assured through protective packaging.

More Information? Circle Item 76 on Inquiry Card.

Automatic Reset Timers

A new series of automatic reset timers, designed to delay an operation or to operate a circuit for a preset time after remote pilot action, is available from Paragon Electric Co., Inc., Two Rivers, Wis.

The new 500 Series timers are particularly suited for motor control, electric equipment delay, heating and air conditioning applications, for vending machines, machine tools, in process control or other applications where time delay and automatic reset is required. They are driven by continuous running sychronous motors which are said to assure greater timing accuracy and to simplify circuitry by eliminating a motor shut-off switch.

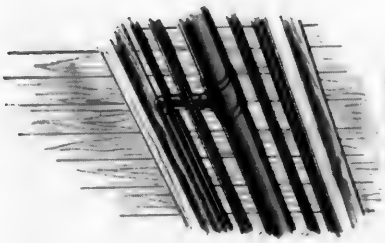


Float switches, pressure switches, pushbutton, limit switches, relay contacts or any conventional power switches can be used to pilot the timers. Sharply defined dials assure accurate settings over a broad timing range from 2 seconds up to 5 hours, depending on the model used. Three types are offered. Type 500, Type 501 and 502, each of which is available with a time range of 1 minute, 3 minutes, 5 minutes, 1 hour or 5 hours, adjustable within the range.

More Information? Circle Item 77 on Inquiry Card.

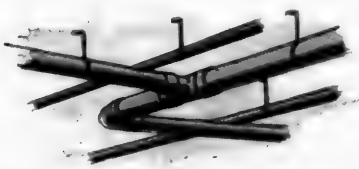
WHY . . .

Remodel with Copper tube???

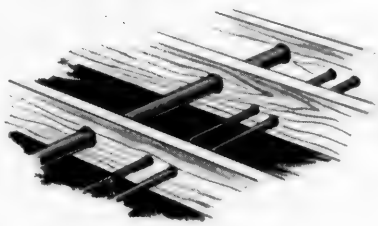


BECAUSE
it can be quickly installed between original floor joists

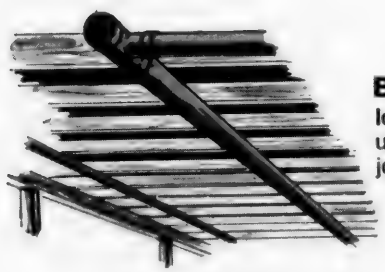
BECAUSE
risers can be installed in original stud spaces



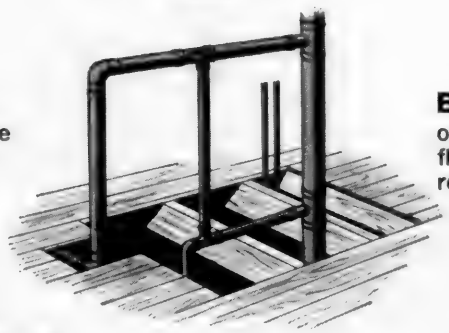
BECAUSE
its light weight makes overhead work easier and faster



BECAUSE
it can be fitted through small holes in old joists



BECAUSE
long lengths can be used with fewer joint connections



BECAUSE
only small areas of flooring need be removed to install it

Anaconda Copper Tube is available in all standard wall thicknesses—Types K, L, M and DWV—through your plumbing wholesaler. See him also for Anaconda wrought and cast solder-joint fittings. For complete information, write Anaconda American Brass Company, Waterbury 20, Conn. In Canada: Anaconda American Brass Ltd., New Toronto, Ontario.

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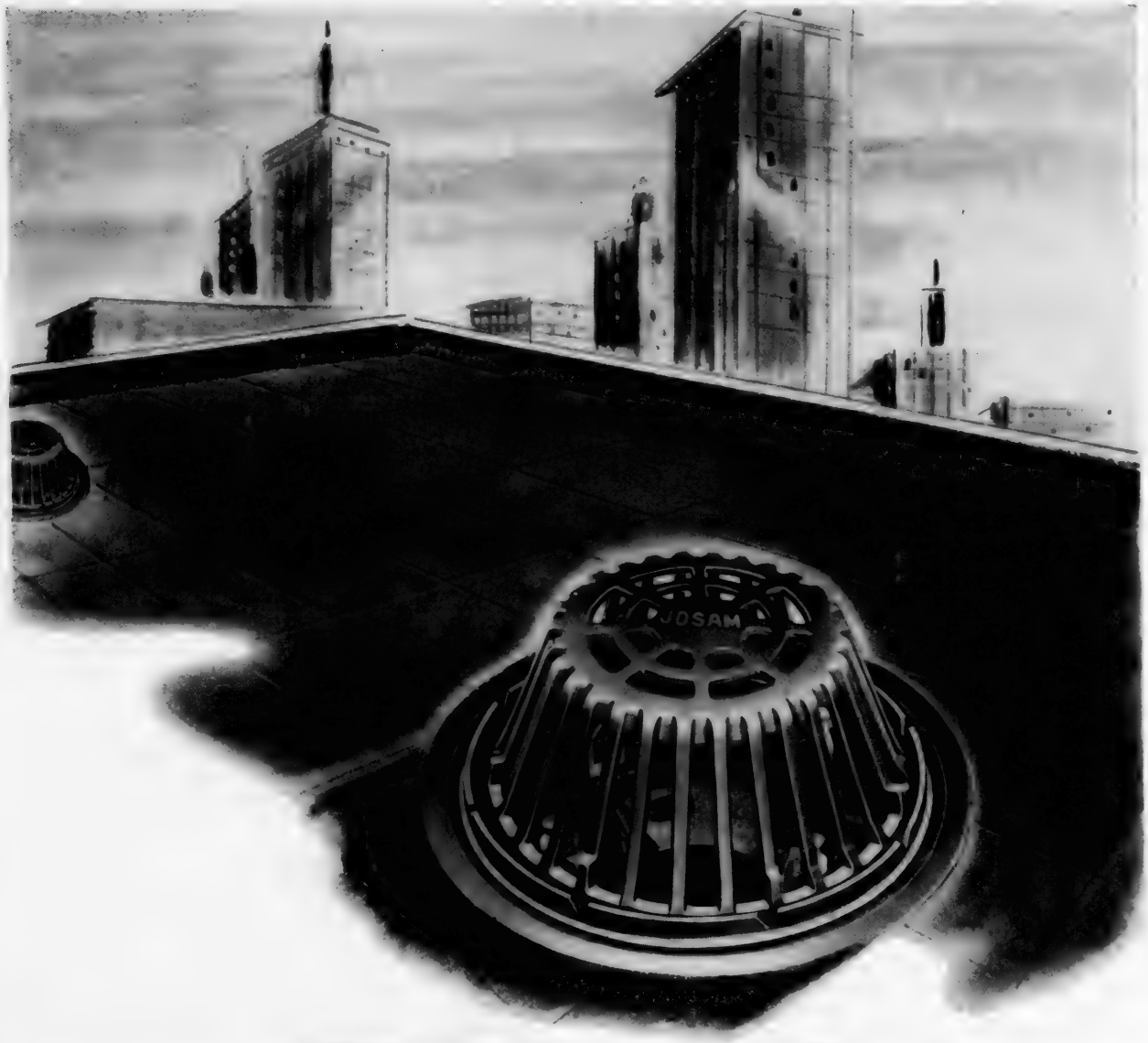
ANACONDA
AMERICAN BRASS COMPANY



When comparing costs...consider

The Advantages which you cannot see in a Josam Drain

When you buy anything that must last a lifetime or longer — even small differences in products are important. This is especially true of drains. Once installed in a building, they are expected to render long-lasting dependable performance, since replacement causes great inconvenience and expense.

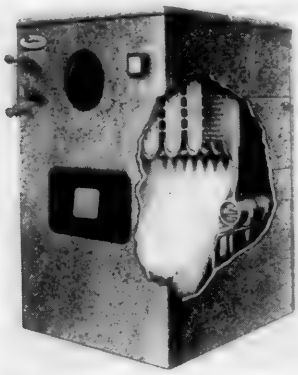
This is why Josam builds the very best in every product it makes. Higher quality of materials, advanced features of design, rigid standards of inspection, quicker availability of stocks are just a few of the advantages you cannot see in a Josam drain — yet they are there, and at no higher cost. Over 45 years of leadership is proof of the superior performance you get in every Josam Product.

JOSAM MANUFACTURING CO.
General Offices and Manufacturing Division • Michigan City, Ind.
REPRESENTATIVES IN ALL PRINCIPAL CITIES
West Coast Distributors
JOSAM PACIFIC CO.
765 Folsom Street San Francisco 7, Calif.
JOSAM PRODUCTS ARE SOLD THROUGH PLUMBING SUPPLY WHOLESALERS
Manufacturers and Representatives in Mexico — HELVEX, S.A., Mexico City

Oil and Coal Fired Boilers

Thatcher Furnace Co., Garwood, N.J., manufacturer of furnaces, boilers, and air conditioners, announces its new Blue Line oil-fired cast iron boilers in 14 large sizes. Also suitable for stoker firing with anthracite coal, the units are designed for apartment houses, large homes, and commercial service.

Vertical flue travel combined with hundreds of



heat absorbing pins on the surfaces of the boiler sections enable a low stack temperature and minimum draft. Other features include cast iron construction, large nipple ports, long water legs, leakproof joints and reversible for choice of boiler location.

More Information? Circle Item 78 on Inquiry Card.

Notebook Provides Project Control

The task of keeping proper records of research and development activities is made easy by the Laboratory Notebook just introduced by Scientific Notebook Co., Oak Park, Ill.

The hard-cover, permanently-bound book provides a record of laboratory and engineering work on specific projects. It is equally valuable for patent record verification and for continuous monitoring of a project's progress by research directors.

More Information? Circle Item 79 on Inquiry Card.

Gas-Fired Unit Heaters

American-Standard Industrial Div., Detroit, Mich., announces its new line of Series NB gas-fired unit heaters equipped with centrifugal blowers. Because of their low operating noise level, heaters are recommended for use in installations where the need for extreme quietness of operation rules out conventional propeller fan type units.

The heaters have been tested and approved by the American Gas Association for use with natural, manufactured, mixed and liquefied petroleum gases, in-

cluding L.P. gas-air mixtures. They are available in 8 basic sizes with heating capacities from 50,000 to 250,000 Btu per hr input.

Safety features include a high limit switch, gas valve, constant burning pilot, pilot switch, gas pressure regulator, and blower delay switch, which delays the start of the blower motor until the heat exchanger reaches a predetermined temperature. The entire heat exchanger is made of aluminized steel for optimum heat transfer and high corrosion resistance.

More Information? Circle Item 80 on Inquiry Card.

Heater Uses Fused Quartz Elements

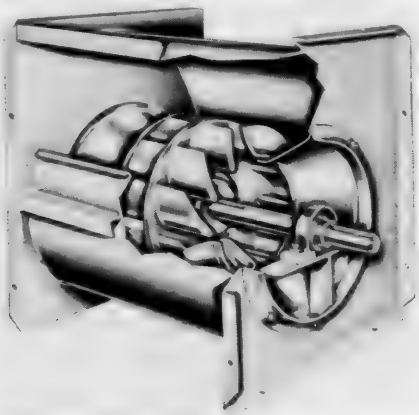
An infrared heater using fused quartz heat elements is available from Pinco Inc., Chicago, Ill. The 800 watt, 120 volt heater reaches its peak temperature in one minute. It is 26 inches long, 5 inches high, and can be installed quickly either to a control box or plugged into a convenient wall outlet.

The heater, which requires no special wiring, is suited for use in basements, patios, swimming pools, cabanas, motels, toll booths, and other installations.

More Information? Circle Item 81 on Inquiry Card.

New Fan Line Offered

Aerodynamic design of wheel and housing inlet enables this new line of fans to operate more quietly at lower speed and with greater efficiency. Introduced by Chicago Blower Corp., Franklin Park, Ill., the fans require less power, meaning that smaller



motors can be used to reduce power consumption and save installation space.

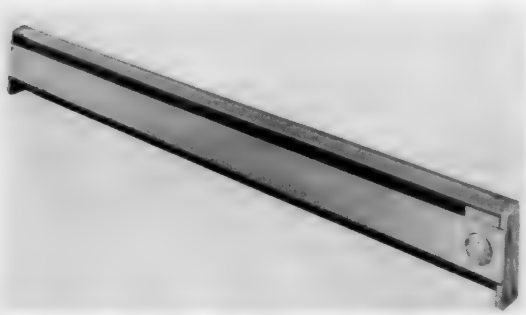
The fans are made in seven sizes, from 8¾ to 18¼ inches, in both single and double inlets up to 9-inch static pressure. Air volume ranges up to 15,000 cfm with temperatures up to 200 deg F.

More Information? Circle Item 82 on Inquiry Card.

Electric Baseboard Heater Control

An electric baseboard control, manufactured by Markel Electric Products, Inc., Buffalo, N.Y., serves as a built-in heat limiting device which protects the entire length of the heating element.

The new Markel LC limits the heater to a safe normal operating temperature when the air flow is restricted in any way. The LC does not permit the heater to exceed the normal operating temperature,



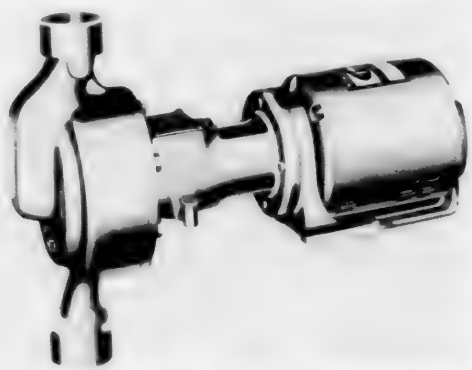
even when partially or completely blocked. When the air-blocking material is removed, it automatically returns the temperature control to the thermostat, requiring no resetting or adjustment.

The LC is available in complete baseboard units from 3 ft (750 watts) to 8 ft (2000 watts) with or without the built-in thermostatic control. It is also available in modular systems for commercial and industrial installations.

More Information? Circle Item 83 on Inquiry Card.

Pump Series Expanded

Taco Heaters, Inc., Cranston, R.I., announces the expansion of its 1600 Series high head pump from six to twelve sizes. The series is engineered to pump water against relatively high heads on low pressure systems. They are used primarily in air conditioning



systems, cooling towers, bottle washers, auto laundries, and similar applications.

Available with single or three-phase motors, the pumps range in size from ¼ hp to 1 hp and operate at 1750 rpm. They feature dynamically balanced closed type cast iron or bronze impellers. The shafts are precision ground stainless steel.

More Information? Circle Item 84 on Inquiry Card.

Stainless Steel Ball Valve

The Lunkenheimer Co., Cincinnati, Ohio, announces the addition of a precision ball valve in Type 316 stainless steel to its line of valves. The new valve, which is available in ¼ to 2-inch sizes, is designed for corrosive fluids and gases and for general use in corrosive services.

A feature of the valve is its precision construction. It is designed and manufactured to extremely close and accurate tolerances, eliminating the need for adjustment or take-up maintenance while in service. Teflon seats, for example, are precision molded and then machined to insure perfect mating between the seat and ball surfaces. Internal springs or compensators to counteract wear at the most critical points are not needed.

More Information? Circle Item 85 on Inquiry Card.

quiet please

Men in white clean and sterilize Adsco Expansion Joints with steam and detergents, dry, and hermetically seal them in polyethylene bags. At an Air Force Titan missile base, system contamination is less than 25 parts per million, with no particle larger than 150 microns.

Cleanliness of this magnitude reveals the slightest imperfection. The construction of these expansion joints which glisten like diamonds is revealed as not just good, but perfect; one slip could bring disaster.

When special designs and/or services with quality workmanship and dependability are required...call on Adsco.

ADSCO EXPANSION JOINTS BEING SCRUPULOUSLY CLEANED BEFORE OPERATION

ADSCO DIVISION

20 MILBURN STREET
BUFFALO 12, NEW YORK

YUBA

YUBA CONSOLIDATED INDUSTRIES, INC.

One single source of burners for most every application—that's what Power Flame offers you! In the fact-packed Power Flame Catalogue, you'll discover a complete range of models and sizes in atmospheric burners, power burners and combination burners. All designed for lowest installation and maintenance costs . . . all "torture tested" for highest efficiency and dependability. Hot idea: Next time, consult Power Flame *first!*

Thoro-Mix
Ceramic Head
GAS BURNERS

With no metal parts in the heat zone, costly maintenance is eliminated. Wide range of burner sizes available, from 200,000 to 12,000,000 BTU.

U-400 Series
(vertical flame) fires ALL types of firebox boilers.

Features:
- Molded refractory heads and diffusers
- All welded manifold with installed orifices
- Minimum installation time required
- Equipped with controls for maximum safety.

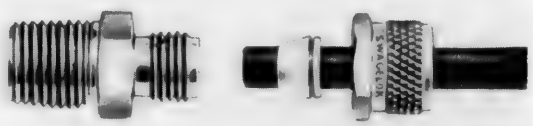
GV Series (horizontal flame) for firebox and scotch marine boilers.

Write today for complete literature, information and specifications on THORO-MIX Gas Burners; also, get all the facts about POWER-FLAME gun type and spread type burners, and COMBI-MATIC dual fuel burners.

Power Flame Division, Inc. / 1203 MAIN ST GRANDVIEW, MO

Fitting For Polyethylene Tubing

A fitting for leak-proof assembly with polyethylene tubing for vacuum pressure applications is being manufactured by Crawford Fitting Co., Cleveland, Ohio.

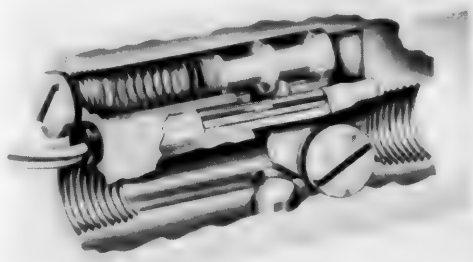


Called Swagelok Kayzee, the fitting consists of a brass fitting body with Zytel ferrules and a brass knurled nut. A wrench pad on the nut permits the use of a wrench if desired.

More Information? Circle Item 86 on Inquiry Card.

Externally Adjustable Flow Switch

The FS-10798 Flow Switch, a product of The Gems Company, Inc., Farmington, Conn., is field adjustable to detect variations in the flow rate of fluids or gases for a positive indication. The switch may operate a remotely located warning light or other indicator, visual or audio. Used in conjunction with a flow meter it can be adjusted to give warning or control at a predetermined flow.



Displacement of the magnet-equipped shuttle by a fluid or gas actuates the hermetically sealed switch contacts. An externally adjustable vane-type, by-pass valve provides a continuous range of actuation from .1 to 10 gpm for fluids and from .5 to 30 scfm for gases.

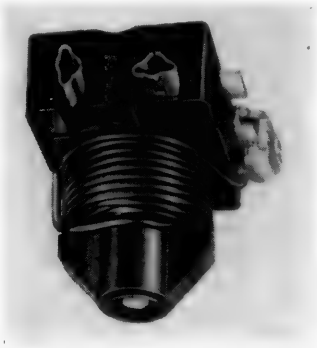
The FS-10798 comes with ½-inch NPT inline ports which can be installed in any straight line of piping. All components are corrosion resistant for maximum dependability and there are no diaphragms or linkages to wear.

More Information? Circle Item 87 on Inquiry Card.

Relay Features Plug-On Terminals

A push-on type current motor starting relay, for use on hermetic compressors having pin-type terminal clusters, is announced by Metals & Controls Inc., Attleboro, Mass.

The relay can easily be installed by pushing it onto the compressor terminal pins. This eliminates the



need for mounting brackets, screws, and special leads and greatly reduces installation and material costs.

The relay cover and spool are made of a strong, high temperature phenolic. The internal mechanism consists of a solenoid coil, a steel armature and a bridging type contact arm. The relay is said to provide an exceptionally long, trouble-free service life.

More Information? Circle Item 88 on Inquiry Card.

Inexpensive Ballcocks Announced

Curtin Valve Co., Medford, Mass., announces its Curtin Jr. No. 150 and Curtin Jr. Anti-Syphon No. 150-A ballcocks which it says will withstand more wear, abuse and corrosion than other inexpensive types. Maximum discharge of water without noise on any pressure and quick refill are other features.

Incorporated in the ballcocks is a replaceable nylon seat which reduces wear, pressure control regulator to allow full volume of water, and a patented aspirating chamber, which prevents water spurting, air hammer, and insures quiet operation.

More Information? Circle Item 89 on Inquiry Card.

Improved Fabric Weatherstripping

A new fabric weatherstripping has a weave which produces a pile more uniform and concentrated to reduce air and moisture infiltration, and a smooth backing for easier insertion into extrusions, according to its manufacturer, Schlegel Mfg. Co., Rochester, N. Y.

The woven weatherstripping is coated with polyester resin and is available with or without metal backing.

More Information? Circle Item 90 on Inquiry Card.

For Air Conditioning

Thermal expansion valve set accurately in less than a minute with the . . .

Alnor PYROCON®

Eliminate the clumsy, slow thermometer method of determining temperatures in the system.

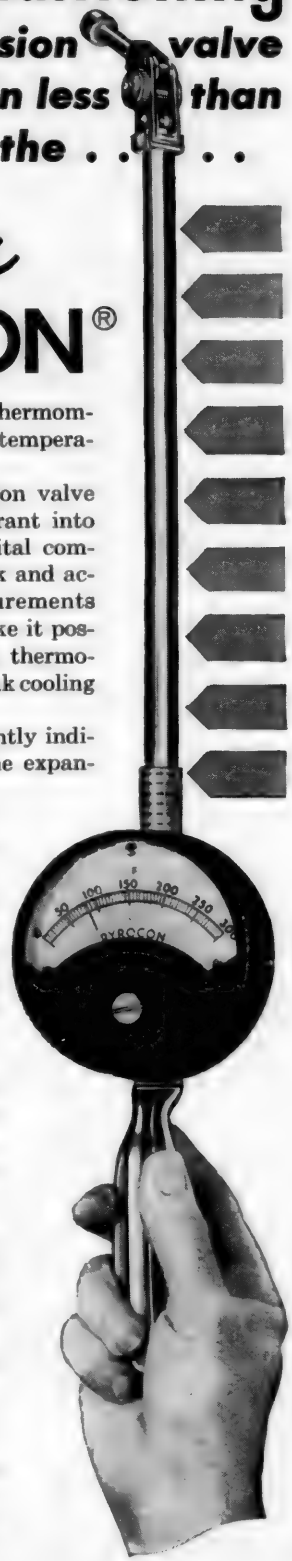
The thermostatic expansion valve controls the flow of refrigerant into the cooling coil and is a vital component of any system. Quick and accurate temperature measurements with the Alnor Pyrocon make it possible to properly adjust the thermostatic expansion valve for peak cooling coil efficiency.

The Alnor Pyrocon instantly indicates the temperature at the expansion valve bulb location. From this temperature, subtract the temperature corresponding to the evaporator pressure. The temperature difference represents the precise superheat and enables the operator to make a perfect setting of the expansion valve immediately.

Pyrocon model 4000 with a temperature range of 0-300° F. is recommended. Price with case including shielded thermocouple tip $125.00 f.o.b. Chicago.

The Pyrocon is also ideal for testing steam traps, balancing hot water systems, locating hot water pipes in cement floors, testing panel heating in walls, floors or ceilings, or making any surface temperature reading.

Other models with ranges up to 0-2000° F. and sub-zero ranges also available.



Write for Bulletin 4257

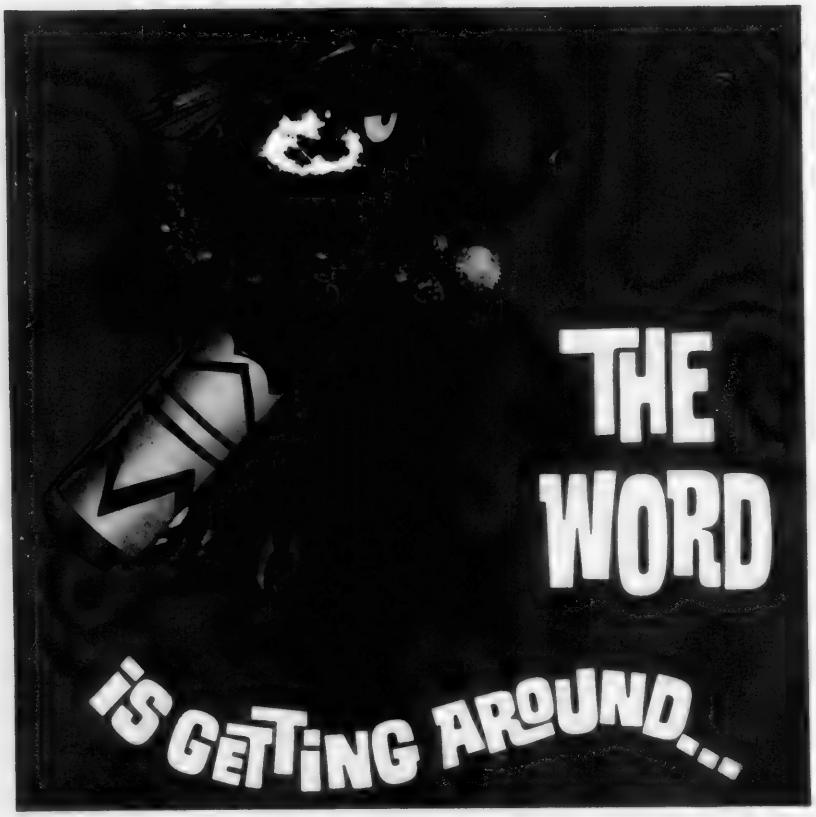
Alnor INSTRUMENTS

ALNOR INSTRUMENT CO.

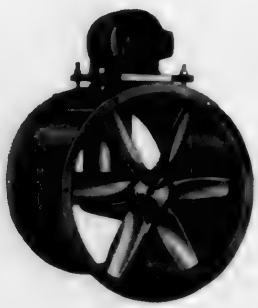
Division of

Illinois Testing Laboratories, Inc.

Room 570, 420 N. La Salle St., Chicago 10, Ill.



that Hartzell Duct Fans offer high efficiency, low maintenance and UNIQUE FLEXIBILITY



High efficiency, low maintenance . . . *and* unique flexibility made possible by the use of variable pitch drives which allow you to vary fan speed and air delivery by up to ⅓ through simple adjustment of the driver sheave. That's why Hartzell duct fans are so widely used in industrial duct systems. And these fans are so easy to install, they bolt right into any duct system as quickly and simply as another section of duct work. Belt-drive and direct-connected models in sizes from 12" to 60", plus special Bi-Pass model which can be used to handle air at temperatures as high as 550° F.

(Continued from page 10)

CUSTOMS TIGHTENS REGULATIONS FOR MARKING FOREIGN FITTINGS

Marking of imported forged steel welding fittings and flanges with metal tags to show country of origin will no longer be acceptable, the U. S. Bureau of Customs has ruled.

In announcing the new position, Philip Nicholson, Commissioner of Customs, stated that "it has been found that the marked metal tags that are welded to the welding fittings and welding flanges are not remaining on the articles until they reach the ultimate purchaser."

After October 17, 1961, marking a country of origin must be by raised lettering or diesinking.

NEW FEDERAL QUESTIONNAIRE CUTS A/E FIRMS' FILING CHORES

A new Architect-Engineer Experience Data Questionnaire (Standard Form 251, June 1961 edition) has been announced by the Bureau of the Budget. Issued by the General Services Administration, with the approval of the Bureau of the Budget, the new form will go into effect on December 1st, and will be used by all departments and agencies of the United States Government, except the International Cooperation Administration. This one exception was made because of the extensive information required by ICA's foreign operations.

The new form is the result of an urgent request by the Consulting Engineers Council the organization's *Newsletter* states, for a standard form that would be applicable to all government departments and would eliminate the time-consuming necessity of filing a different form for each Federal agency. Form 251 is designed to provide uniform information by all architectural-engineering firms relative to professional status.

The form will be used in lieu of any other Government form

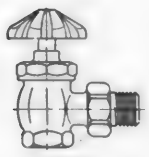
(Continued on page 140)

Easy to do!

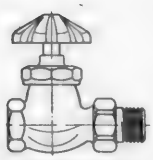
The stop screw in the sectional view below provides the orifice adjustment. Simply close the valve, remove the handle-screw and insert screwdriver in the open stem to engage slot in stop screw. Turn the stop screw as far down as it will go. Then back it off to the required orifice opening.

In a steam system, back stop screw one turn for each 10 sq. ft. of direct radiation. In a hot water system, as many turns as indicated by flow requirements of system, either precalculated or checked by devices for determining flow.

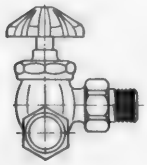
Note that valve is non-rising stem type and can only be opened to position permitted by stop screw setting. Provision is made for sealing the adjustment tamper-proof after setting orifice.



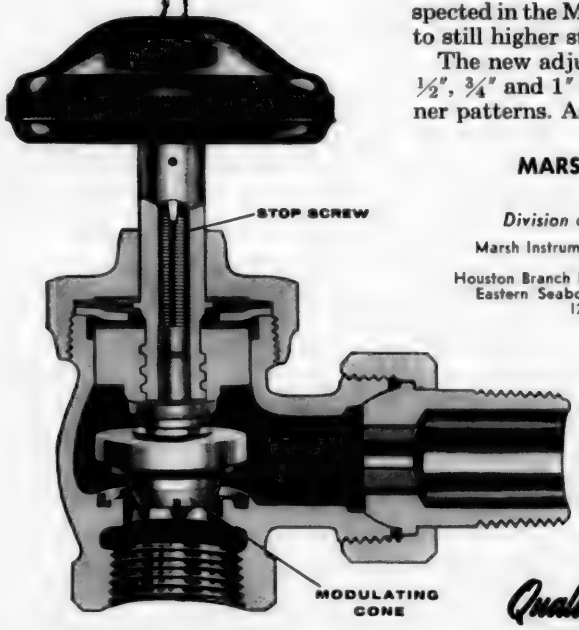
Angle



Straightway



Corner—either right or left hand



Marsh Presents

A Superior Adjustable Orifice Valve

Here is the answer to easy, highly efficient balancing of both steam and hot water systems...a radiator valve in which you can accurately adjust orifice opening with the twist of a screwdriver; without shutting down the system; without breaking the union connection.

A stop screw in the valve stem, as illustrated here, enables you to set the modulating cone for any required flow: on steam, from 10 to 100 sq. ft. E.D.R.; on hot water, to any indicated flow at any given pressure.

Read opposite how simply and effectively the flow is adjusted. Once the opening is set, the special taper of the modulating cone assures the correct flow of steam or water through the orifice at any opening. In other words, the flow curve through the valve at *any* given pressure is a *straight line* throughout the full range of valve opening. Since the adjustment only limits the amount of opening, shut-off is positive at any adjustment without disrupting orifice setting.

A new valve with time-tried Marsh design

This feature is all the more significant because it is found in a valve that incorporates the truly packless, metal-to-metal seal construction so highly respected in the Marsh R-100 series and now brought to still higher standards.

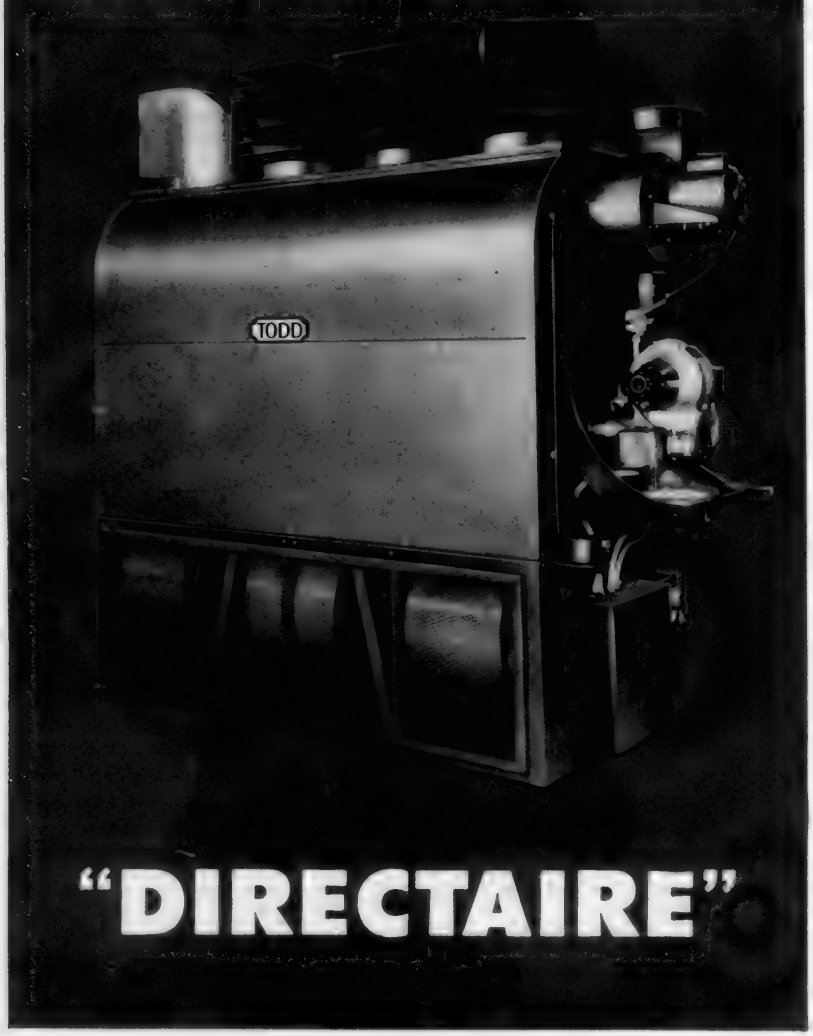
The new adjustable R-105 series is available in ½", ¾" and 1" sizes; angle, straightway, and corner patterns. Ask for special bulletin.

MARSH INSTRUMENT COMPANY
Dept. U, Skokie, Illinois
Division of Colorado Oil and Gas Corporation
Marsh Instrument & Valve Co. (Canada) Ltd., 8307 103rd St. Edmonton, Alberta, Canada.
Houston Branch Plant, 1121 Rockwell St., Sect. 15, Houston, Texas.
Eastern Seaboard Warehouse: Marsh Instrument Company, 1209 Anderson Ave., Fort Lee, N.J.

MARSH

Quality Heating Specialties since 1865

FIRST FOR EFFICIENCY



"DIRECTAIRE"

COMPLETE SINGLE PACKAGE UNIT

LOWEST-COST HEATING

•

HEATING & VENTILATING

FACTORIES • WAREHOUSES
OFFICES • STORES
GARAGES • INSTITUTIONS
MANUFACTURING PROCESSES

FLEXIBILITY at minimum cost—as completely self contained heating system or in conjunction with existing heating and air conditioning (same ducts can be used). Easy installation, floor or overhead, with fully wired control panel ready to connect.

TROUBLE-FREE performance with high efficiency output of warm air and ventilation at correct sustained volume. For every type of space heating or for manufacturing processes under strict thermostatic control, "DIRECTAIRE" is the system with "built-in" economy.

WRITE FOR "DIRECTAIRE" BOOKLET 30X

TODD PRODUCTS

A DIVISION OF TODD SHIPYARDS CORPORATION

Sales and Engineering: Columbia and Halleck Sts., Brooklyn 31, N. Y.
Manufacturing: Green's Bayou, Houston, Texas

(Continued from page 138)

whenever an agency desires to contract for A/E services in connection with construction, alteration or repair of buildings, bridges, roads, or other kinds of real property. Use is not required in the procurement of such services related to vessels, aircraft or other similar types of personal property.

TUBE TURNS SEEKING IDEAS FOR NEW PIPING PRODUCTS

In a letter to engineers, designers and technicians, Tube Turns, Division of Chemetron Corp., Louisville, Ky., is soliciting ideas for unique piping products, as well as for improvements in its present product line. It has set up a committee to consider suggestions as submitted.

"If you (or others in your organization) are working on, or have completed, a new design having utility in any of the broad fields of modern piping," the letter states, "you are invited to contact Tube Turns as a prospective developer and/or marketer of your ideas".

The New Product Evaluation Committee, whose chairman is T. H. Pike, Jr., vice-president for sales, P.O. Box 987, Louisville 1, requires that all communications be in writing and that they be sufficiently detailed to permit a full understanding of the proposed product's construction and advantages, and evaluation of its manufacturing requirements and market potentials. Ordinarily, no material will be returned, the letter states, nor should an idea be submitted on the expectation that it is to be held in confidence or maintained secret. If the submitter has not filed an application for a patent on his idea, then all sheets of drawings and descriptive material submitted should be signed and dated by the submitter and attested by a notary or signed and dated by two reliable witnesses, and the submitter should retain duplicates.

(Continued on page 142)

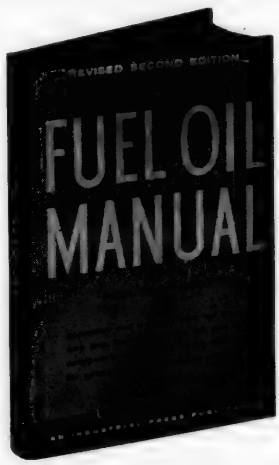
Centridyne BY WESTERN

The new compact centrifugal roof ventilator. Advanced styling as low as 11½"

WRITE FOR TECHNICAL INFORMATION

WESTERN ENGINEERING & MFG. CO.

P.O. Box 66455 • Los Angeles 66, California



Here is a book that will give you a comprehensive picture of the characteristics and uses of every type and grade of fuel oil. The author explains the meaning of each oily property, and shows how this information is applied to the selection, handling and burning of fuel oil. Impurities and how they affect combustion are described fully, and a special chapter describes fuel oil additives and how they are used. Another chapter lists troubles which may be encountered in using fuel oils, and shows the correct remedy to apply in each case. Technical language is avoided wherever possible and all terms are fully explained.

160 Pages **$5.00** **34 Tables**

THE INDUSTRIAL PRESS

93 Worth Street **New York 13, N. Y.**

NEW! The high quality of

STAINLESS STEEL

. . . at lower cost!

TRERICE BX SERIES ***INDUSTRIAL***

THERMOMETERS

Now available! The new high-quality, low-cost Trerice BX Series Thermometer with stainless steel front and bulb chamber. Easy-to-read scale markings . . . large red appearing mercury tube . . . durable 9-inch cast aluminum case. Guaranteed accurate temperature indication! Available in standard range models from —40°F to 950°F. No extra cost for straight, right side, left side, regular angle, regular oblique, or reverse oblique forms.

H. O. TRERICE CO.
1420-A W. Lafayette Blvd., Detroit 16, Mich.

Please send bulletin 201 describing Trerice BX Industrial Thermometers!

NAME_____

ADDRESS_____

CITY_____ ZONE____ STATE_____

TRERICE TEMPERATURE AND PRESSURE INSTRUMENTS

which size stack do YOU prefer?

Each does the same job—the smaller one is equipped with a Lehigh Induced Draft Fan

Lehigh Induced Draft Fans are designed to help eliminate large, costly, unsightly stacks. They maintain a *constant* over-fire draft regardless of atmospheric conditions, help keep boilers operating at *maximum* efficiently at all times, and significantly *lower fuel bills* . . . while radically *reducing* the size of your stack.

Rugged Construction—long life: to prevent distortion under elevated temperature conditions, the fan housing, bearing pedestal, motor support and fan wheel of Lehigh Draft Induced Fans are constructed of all-welded integral ⅜" mild steel. A radiant heat cover and an aluminum heat flinger protect the inboard bearing from radiated heat. And because both bearing and shaft are kept to a low operating temperature, the Lehigh Induced Draft Fan makes use of standard, self-aligning ball bearing pillow blocks. *All* Lehigh Induced Draft Fans feature a flanged inlet, flanged outlet, and inspection cover as standard equipment.

If you would like to reduce stack height . . . and gain optimum boiler efficiency . . . contact your local Lehigh Representative today. He'll gladly give you all the details. Or write directly to us for our detailed technical bulletin: 2171 LF-1

LEHIGH FAN & BLOWER DIVISION
FULLER COMPANY, CATASAUQUA 5, PA.
Subsidiary of General American Transportation Corporation

LEHIGH

(Continued from page 140)

AIR DIFFUSION COUNCIL FORMED; INDUSTRY STANDARDS IS GOAL

Air Diffusion Council, a new trade association in the air distribution field, has been incorporated under the laws of the State of Illinois. Members are manufacturers of grilles, registers, ceiling diffusers, air flow control equipment and terminal air control devices. A prime objective of the group is to develop an industry-wide testing and rating standard for use by industry, government, architects, engineers, heating contractors and building contractors. The association will also encourage basic research into the scientific laws governing the behavior of air streams in enclosed areas.

Substantial progress has been made in outlining testing and rating standards during the period immediately preceding formation of ADC, the Council office stated, and reports will be issued as this project progresses.

In addition to establishing this standard, the Council also plans to launch an educational program to increase knowledge of the science of air distribution among all individuals involved in specification, purchase, installation and utilization of air distribution equipment.

Charter members of the Council are: Anemostat Corp. of America, Buensod-Stacey, Carnes Corp., Conor Engineering Corp., Titus Manufacturing Co., Tuttle and Bailey—Division of Allied Thermal Corp., and Waterloo Register Company.

Officers elected at the first meeting, to serve during 1961-62, are: R. D. Tutt, Tuttle and Bailey, president; P. F. Canavan, Conor Engineering, vice-president; D. Titus, Titus Manufacturing, secretary; and C. T. Roff, Anemostat Corp. of America, treasurer.

Air Diffusion Council is managed by Smith, Bucklin & Associates, professional trade association management firm. Address of the Council is 333 N. Michigan Avenue, Chicago 1, Illinois.

MERITS OF PRIVATE CONSULTANTS OUTLINED FOR HOUSE COMMITTEE

Members of the House Armed Services Subcommittee on Special Investigations heard testimony in strong support of the continued use, by state and federal agencies, of the services provided by engineers in private practice. Citing specifically the many advantages to government public works agencies of using engineers in private practice, was Harold P. King, partner in the Sherman Oaks, Calif., consulting firm of King, Benioff & Associates, and president of the Consulting Engineers Council.

According to Mr. King, who testified on the matter of "contracting out" procedures of the military branches, advantages to the government and, therefore, to the public, through use of services provided by consulting engineers are:

(1) Affirmation of the principle of private enterprise, (2) Greater national security, (3) Opportunities for selecting specialists, (4) Greater alertness through effective prosecution of the work, (5) A deterrent to over-expansion of governmental staffs, (6) True and complete records of engineering costs, and (7) Economy.

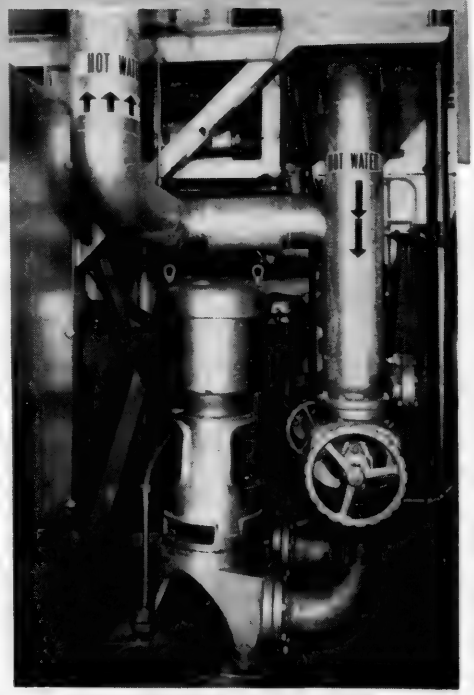
Private Enterprise at Stake

Pressures for increased use of Defense Department personnel and facilities, rather than "farming out" projects to private industry, and the question of relative costs, are reported to be reasons which prompted the Armed Services Subcommittee Special Investigation. Mr. King said that if the philosophy of using engineers in private practice is eliminated by government agencies, it will lead to a complete destruction of an important segment of the private enterprise system. "From time-to-time," he said, "we must all reaffirm our belief in the principle of private enterprise. We do not wish to infer that this principle applies to engineers only, but that it should be the guide for

SPECIFY THE weil

VKY Space Saving

VERTICAL CIRCULATING PUMP



for

CIRCULATING • HOT WATER FOR HEATING

CIRCULATING • CHILLED WATER FOR COOLING

CIRCULATING • CONDENSER WATER

BOOSTER • PUMP SERVICE

Capacities to • 750 GPM.

QUIET OPERATING EFFICIENT PERFORMANCE

An all ball bearing pump designed for continuous operation!

THE weil VKY pump . . .

The highly efficient VKY PUMP requires only one shaft seal. Supply and discharge piping are on one side only. All operating parts may be removed without disturbing any piping connections. Motor is a standard frame NEMA C mount with standard shaft extension. Vibration is eliminated by three rubber vibration eliminator mounts. Noise transmission is reduced to an absolute minimum.

SEND FOR BULLETIN VKY-6900.

weil PUMP COMPANY

1516 N. Fremont Street, Chicago 22, Illinois

(Continued from page 143)

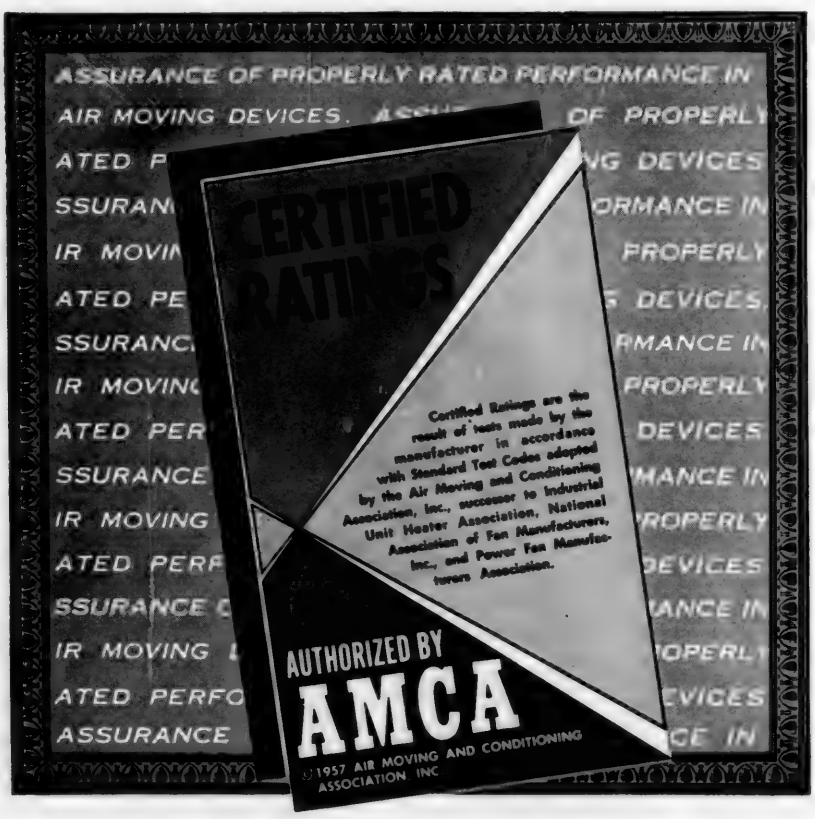
our government in the procurement of all services and goods."

With reference to greater national security, the CEC president pointed out that the use of private practicing engineers by government can provide a very important reservoir of highly qualified specialists whose services are available in times of emergency.

As to obtaining specialists, Mr. King said — "Consulting engineers in private practice can be selected whose qualifications are particularly suited to that required for a specific project. The present method in use by the Armed Forces for obtaining professional services by interview and negotiation provides an opportunity for the selection of a properly qualified firm."

Directing his remarks at government waste, Mr. King said— "Private engineering firms can stay in business only if they are receptive to new ideas and more economical methods of providing quality service. However, it seems that, in general, the competitive challenge to adopt new concepts does not exist in many government engineering staffs."

"Consulting engineers in private practice" said the CEC president, "are acustomed to executing work under pressure and thereby comply with time schedules as specified in contracts. Therefore, the retention of consulting engineers reduces the posibility of unwarranted delay to the minimum."


ASSURANCE OF PROPERLY RATED PERFORMANCE IN
AIR MOVING DEVICES.
CERTIFIED RATINGS
Certified Ratings are the result of tests made by the manufacturer in accordance with Standard Test Codes adopted by the Air Moving and Conditioning Association, Inc., successor to Industrial Unit Heater Association, National Association of Fan Manufacturers, Inc., and Power Fan Manufacturers Association.
AUTHORIZED BY
AMCA
©1957 AIR MOVING AND CONDITIONING ASSOCIATION INC

IT'S WHAT'S BEHIND THE SEAL...THAT REALLY COUNTS

AMCA IS BEHIND THIS SEAL—Only manufacturers who meet the rigid requirements for testing and rating air moving devices under the certified ratings program are licensed by AMCA to use the Certified Ratings Seal.

PROPERLY-RATED PERFORMANCE IS BEHIND THIS SEAL—Only performance rating data developed in accordance with AMCA standard test codes, and based on tests conducted only in AMCA-approved laboratories is accepted for review and license consideration under the certified ratings program.

A CONTINUING RE-TEST PROGRAM IS BEHIND THIS SEAL—All products licensed to use the certified ratings seal are subject to periodic re-evaluation under AMCA's continuing re-test program, and license to use the Seal may be withdrawn by AMCA for non-conformance with requirements.

Copies of Bulletin 261A, "Who's Who in Certified Performance Ratings" are available from: Air Moving and Conditioning Association, Inc., 2159 Guardian Building, Detroit 26, Michigan.

SPARK IGNITION SYSTEM FOR COMFORT HEATING UNITS?

A recent decision of American Gas Association Laboratories Approval Requirements subcommittee may result in the application of the automatic spark ignition system, previously restricted to automatic clothes dryers, to many types of gas heating equipment, including unit heaters, duct and central furnaces, and infrared radiant heaters.

According to Controls Company of America's Heating and Air Conditioning Div., Milwaukee, developer of the system, the direct ignition system eliminates the gas pilot, traditionally the only method of igniting the main burner of gas equipment. Ceiling-mounted gas heaters in stores, plants, or warehouses, the company states, often require special servicing because conventional pilots in these units occasionally are blown out or become clogged by foreign material. Also, in homes without basements, the gas furnace is often located in a relatively inaccessible space, making it difficult to service in the event of pilot outage.

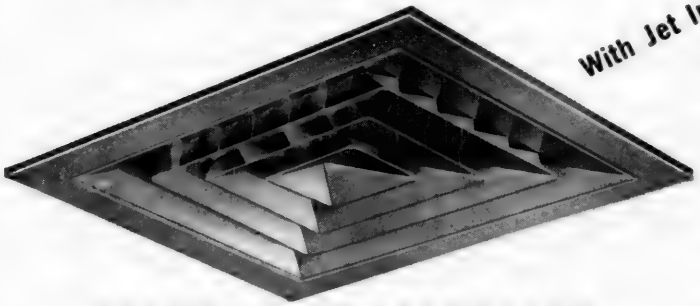
Controls Company of America's "Spark-Lite" unit provides an intense electric spark at an electrode mounted adjacent to the main burner. It is said to incorporate necessary shut-off safety features.

THE ORIGINAL SQUARE AND RECTANGULAR AIR DIFFUSERS

AGITAIR®

GENUINE PRODUCTS

With Jet Induction Diffusing Vanes



STURDILY CONSTRUCTED

- All louvers are firmly welded to diffusing vanes in parallel lines.
- The louvers cannot be tampered with or altered.
- Solid construction eliminates strumming or vibration.
- A metal plate is welded at the corner joints to add greater rigidity to the unit.

MORE THAN 1,000,000 IN USE TO-DAY

Only AGITAIR square and rectangular diffusers employ the jet induction feature due to scientically designed diffusing vanes.

These AGITAIR diffusers with built-in diffusing vanes, are designed and positioned to serve as air pumps, compressing the air into a multiplicity of jets. These jets issuing from spaces between adjacent louvers, produce a high degree of turbulence which rapidly mixes the primary and room air and assures control of the entire cubicle contents of the spaces served.

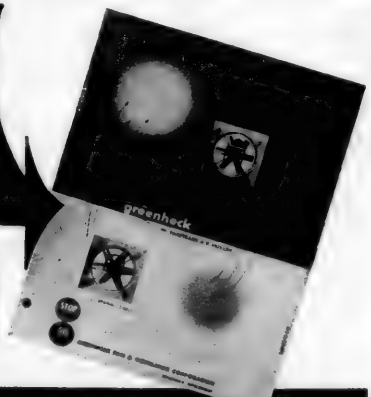
AGITAIR jet induction type diffusers are custom-made with louver arrangements for 1-2-3 or 4 way proportional blows.

Ask for technical catalog R-108

AIR DEVICES INC.
185 MADISON AVENUE, NEW YORK 16, N.Y.

BETTER PRODUCTS FOR
AIR DISTRIBUTION • AIR CLEANING • AIR EXHAUST

NEW! Write today for your copy



It's yours for the asking . . . you'll find it a booklet of value to your work.

Air Movers THAT CAN BE USED IN ALL COMMERCIAL OR INDUSTRY INSTALLATIONS

Fully illustrated, with a most attractive cover, the booklet illustrated above has all the details you need to know on Greenheck Propeller Air Movers . . . construction features, dimensional data, electrical characteristics, performance chart — on both Greenheck Belted Propeller SB-Line Air Movers . . . Greenheck Direct Drive SD-Line Air Movers . . . and Greenheck Economy Line Air Movers — with accessories illustrated. It's definitely the information you'll want to have handy for quick reference.

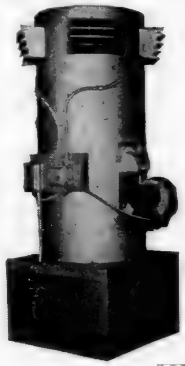
Greenheck Propeller Air Movers are designed for a wide range of applications.

- Factories • foundries • paper mills
- Power plants • garages • farm buildings
- Schools • gymnasium • motels
- Laundries • dry cleaning plants

GREENHECK FAN & VENTILATOR CORP.
SCHOFIELD • WISCONSIN

LOW COST PLANT HEATING!

SAVE ON FIRST COST
SAVE ON INSTALLATION COST
SAVE ON OPERATING COST



Thermobloc Direct - Fired Warm Air Heaters furnish the ideal solution to the problem of high heating costs. Thermobloc heaters are made in a complete range of sizes for all commercial and industrial uses. They are completely automatic — give years of trouble-free-service. There is no wasted heat — Thermobloc puts heat where it's needed, when it's needed.

Write for Information today

WANSON CORPORATION
Lewistown, Pennsylvania

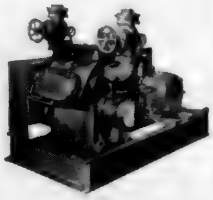
THERMOBLOC
THE WORLD'S LEADING AIR HEATER

( ) Please send new Bulletin on Industrial Heating
( ) Have representative call to explain possible economies of Thermobloc.

Name .....
Company .....
Street .....
City & State .....

Summer Cooling... Winter Curling and Skating - all with ONE refrigeration system

Main entrance to Prudhomme's Garden Centre Motor Hotel in Vineland, Ontario. This exciting summer and winter playground spot uses Vilter refrigeration to good advantage.



Two 6-cyl. Vilter VMC belt-driven compressors provide refrigeration at Prudhomme's for summer air conditioning and winter curling.

The Garden Centre Theatre becomes a regulation six-sheet curling rink during the winter months. The Vilter system is designed to produce ideal curling ice at the lowest possible power cost.

Year 'round use of your refrigeration capacity is sound business and enables maximum profit to be realized from your investment.

An excellent example of the year-'round utilization of refrigeration is Prudhomme's Garden Centre Motor Hotel in Vineland, Ontario, along the Queen Elizabeth Way. At this famous motel, recreation center and convention headquarters, Vilter refrigeration plays an important role in keeping guests happy.

During the summer months, refrigeration is required to air condition the 180-room motel, one of Canada's largest, and an 1100-seat summer stock theatre which draws large crowds to see outstanding stock productions of Broadway plays. In winter months, the same equipment builds ice surfaces for a 90′ x 180′ outdoor ice skating rink and a regulation six-sheet curling rink. The summer stock theatre building is used to house the curling rink with either a seating structure installed or plastic piping laid for the curling rink, depending upon the season.

Vilter equipment installed at Prudhomme's includes two 6-cylinder VMC compressors and a 24″ x 20′ shell and tube condenser.

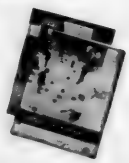
Vilter has had many years of experience in recommending and building refrigeration systems for air conditioning and ice rinks. This know-how, plus the use of dependable economical-to-operate Vilter equipment, can also mean a satisfying installation for you. Why not see your nearest Vilter representative today?

Sold and Installed by VILTER DISTRIBUTOR
J. L. Wilson and Sons, Limited, Toronto, Ontario, Canada

Vilter® refrigeration air conditioning

Vilter Manufacturing Corporation
Milwaukee 7, Wisconsin

Air Units • Ammonia and Freon Compressors • Booster Compressors Baudelot Coolers • Water and Brine Coolers • Blast Freezers Evaporative and Shell and Tube Condensers • Pipe Coils Valves and Fittings • Pakice and Polarflake ice machines.



Write for helpful bulletins to Vilter Manufacturing Corporation Dept. G-614 2217 South First Street Milwaukee 7, Wisconsin

BRIEFLY STATED

NEWS ITEMS

A refrigeration and low temperature consulting and manufacturing service, CRYO-ENGINEERING Co., was established in West Chester, Pa., by Donald J. Barday, former Du Pont Co. Freon Products Division refrigeration engineer. Mr. Barday's organization will offer a complete design service for manufacturers, contractors and industrial users of refrigeration, solvent purification, recovery systems and vacuum apparatus. Cryo-Engineering will manufacture low temperature test equipment, supervise the procurement and installation of equipment, and serve as consulting engineers on proposed and existing installations of clients' equipment.

ASSOCIATION ITEMS

CLEAVER-BROOKS CO., Milwaukee, has become a member of the national BETTER HEATING-COOLING COUNCIL. Cleaver Brooks, will be a member of BHC's Commercial & Industrial Division. . .

BITUMINOUS COAL RESEARCH, INC., is consolidating its Columbus, Ohio, and Pittsburgh research activities in the coal industry's new research center at Monroeville, Pa. The research program will emphasize development of improved coal utilization methods and equipment. The new laboratory can accommodate a staff of 80 to 100, depending on the nature of research being conducted.

Two manufacturing firms have been elected to membership in GAS APPLIANCE MANUFACTURERS ASSOCIATION. Cleaver-Brooks Co., Milwaukee and Van Wert Stoker Mfg. Co., Inc., Peckville, Pa. are the new GAMA members, bringing the trade group's enrollment to 581 manufacturing firms. The manufacturing groups work through their association to promote quality standards, inform the public of new product developments and support those activities that are in the best interests of the industry and its customers.

Briefly Stated

The Conneaut, Ohio, manufacturing division of Strong, Carlisle & Hammond Co. changed its name to STRONG. Reason for the name change is to designate certain proprietary product lines manufactured and sold nationally by Strong. These products include steam traps, control valves, strainers, separators, and blow-down systems.

VAPOR HEATING CORPORATION'S new name is VAPOR CORPORATION. The new title is said to better reflect the diversified operations of the company.

BURGEONING BUSINESS

R. S. Sandifer, a registered professional engineer in Texas and Louisiana, with more than 20 years engineering, design and handling applied equipment experience in his field has formed a new Houston, Texas, firm especially equipped to handle industrial refrigeration and air conditioning sales and service. THE SANDIFER CO., 2518 North Boulevard, will also handle heating equipment and serve commercial establishments and institutions. . .

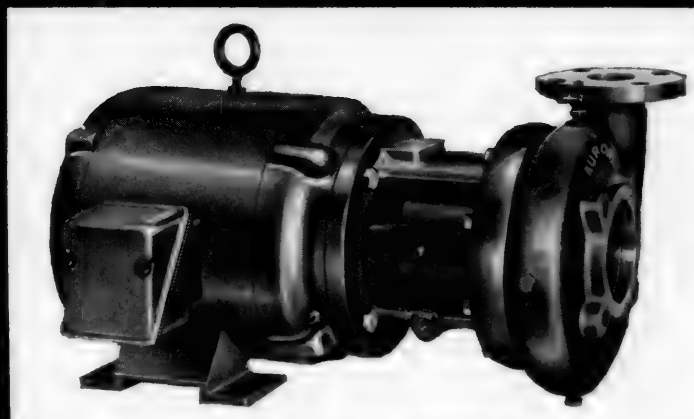
Servisoft, Inc., a wholly owned subsidiary of the George Getz Corp., Chicago, Ill., has merged with Ster-O-matic, Inc., Mundelein, Ill. The surviving company, a Delaware corporation, will be WATER TREATMENT CORPORATION. Its trade mark will be *Waterco*. Ster-O-matic is engaged primarily in research and development and the marketing of new products and systems in the water treatment field. Servisoft, the oldest soft water servicing company in the country, will be the marketing arm of the new Corporation and Waterco will be the product development division. . .

SINKO KOGYO CO., LTD., Osaka, Japan, has been appointed a licensee of BUENSOD-STACY CORP., New York, subsidiary of Aeronca Mfg. Corp. Sinko will manufacture and distribute Buensod-Stacey dual duct high velocity air mixing units

NEW!

AURORA TYPE GBH

HIGH EFFICIENCY, LOW HORSEPOWER CLOSE-COUPLED END SUCTION PUMPS



Capacities to 1600 GPM, heads to 330 feet

Especially designed to provide high efficiency and practical economy, the new Aurora Type GBH pumps are suitable for a wide range of services handling hot or cold liquids. Outstanding features include: Completely interchangeable mechanical seal or packing inserts, permitting fast economical conversion for changed conditions ■ Carefully balanced cast impellers that are keyed and locked in position ■ Shaft sleeve construction with "O" ring seal, providing positive sealing, prevention of corrosion, and extension of seal or packing life ■ Extra-length casing rings to provide positive seal, minimize leakage losses, and lower maintenance costs ■ Balancing rings, on pumps with 2″ and larger discharge, to reduce thrust load on bearings and extend pump life ■ Standard NEMA pump motors.

Optional features further increase the economy and versatility of the Type GBH Pump . . . Impeller rings make it easy and inexpensive to extend impeller life and water jacketed inserts provide for handling hot liquids to 250°F. Find out now how these pumps can serve your needs efficiently and economically.

Ask Now For Free Bulletin #108

AURORA always PUMPS

AURORA PUMP DIVISION

THE NEW YORK AIR BRAKE COMPANY

690 LOUCKS • AURORA, ILLINOIS

LOCAL DISTRIBUTOR IS LISTED IN THE YELLOW PAGES OF YOUR PHONE BOOK

and allied equipment in Japan. Sinko Kogyo is one of the leading manufacturers in Japan of heating, air conditioning and ventilating equipment. . .

KOPPERS CO., INC., Pittsburgh, Pa., dedicated its newest and largest research facility at Monroeville, Pa., on August 28, representing an investment of approximately eight and one-half million dollars. One of the most significant features of the research center is its easy expansibility. At present, only one-third of the buildings planned for the 176-acre site is completed. Designed to handle the research needs of the company for the next 40 years, the Center will eventually house over fifteen-hundred scientists, about four times its initial population. . .

PENN CONTROLS, INC., Goshen Ind., manufacturer of refrigeration and air conditioning products as well as heating controls, acquired the business, good will and principal operating assets of BASO, INC., Milwaukee, manufacturer of controls and other devices for gas burning equipment. . .

CLEAVER-BROOKS CO., Milwaukee, formalized its Heater Division and named O. E. Jacobsen general manager and Walter Schuman sales manager. The division was formerly known as the Road Machinery Division. It manufactures hot oil heaters, Dowtherm boilers, waste heat boilers, sulphur boilers and asphalt heaters for wide application in the petroleum, chemical, construction and food industries. The products are utilized in high temperature processes dependent on steam. . .

WATSCO, INC., Hialeah, Fla., has merged with WAGNER TOOL & SUPPLY CORP. and DEVICES RESEARCH CORP., both of Hialeah. Wagner Tool & Supply and Devices Research will remain as divisions of Watsco, but all business will be conducted in the name of Watsco, Inc. . .

TEMPRITE PRODUCTS of Birmingham, Mich., has acquired ownership of Cordley and Hayes, a New York corporation, through the purchase of all the outstanding stock. Cordley and Hayes will continue to operate as a separate corporation with C. M. Cordley as president. . .

AIRTEMP DIVISION, Chrysler Corporation, opened a branch office in Dallas, Tex. It will be responsible for sales and service of the company's complete line of air conditioning and heating products. Decision to establish the branch was made after the withdrawal of R. R. Matthews, president of Royalair Distributors, from the wholesale air conditioning business. Matthews Engineering Co., mechanical contractors, and Matthews Services, Inc., will remain in the retailing and contracting field. Also, Sabine Supply Co. and Chrysler are terminating their wholesale franchise for room air conditioners. The Airtemp branch will handle the whole line. William C. Ewert, Jr., will head up the Dallas branch office. . .

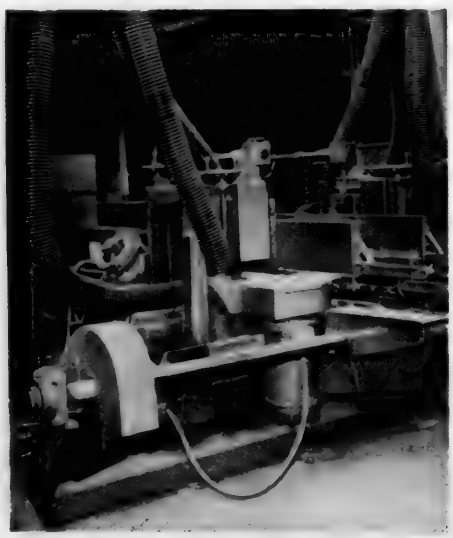
ROBBINS & MEYERS, INC., announced formation of a new division to be known as the AIRTROL DIVISION, to be headquartered in Springfield, Ohio. It will specialize in design, production, and marketing of unit type collectors for control of dusts and mists encountered in industrial and commercial operations. The line will include fabric filter and kinetic cyclone type units. Mist collecting units are designed to alleviate the problem of objectionable condensation, such as that encountered in machine shops. Product distribution will be done by approximately forty representatives, many of whom have already been appointed. Production should start this Fall. E. J. Stone, sales manager of the company's Propellair Division, is assigned managership duties.

(Continued on page 150)

FLEXAUST® HOSE

Dust Collection for Fume Control Materials Handling

MAKES GOOD INSTALLATIONS BETTER



Thousands of successful installations prove that use of Flexaust hose and Portovent retractable duct with metal duct systems lower installation costs — but there are other important advantages.

Exceptional abrasion resistance
Corrosion resistance
Noise absorption
Durability under heavy flexing
Provision for expansion and contraction
Easy relocation of hoods and machines

Made of high quality neoprene coated fabrics 1¼ to 36" i.d.

Write today for full details

Distributors in all principal cities

THE FLEXAUST CO.

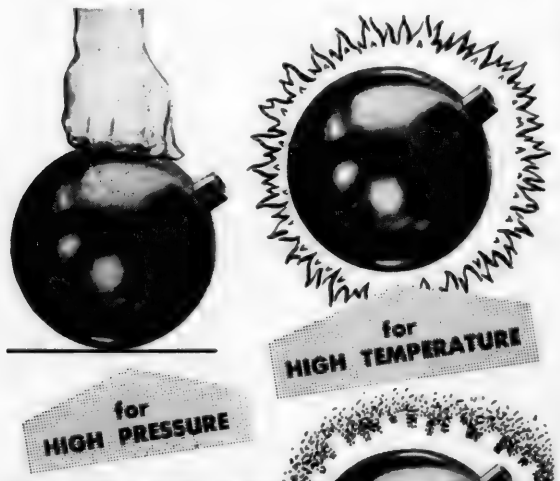
DEPT. HV-10 100 PARK AVE. NEW YORK 17, N. Y.

THE WESTERN SCHOOLBOY

"The Ultimate in Classroom Heating & Ventilating"

The gas-fired SCHOOLBOY UNIT VENTILATOR combines economy and comfort with quietest operation. 1200 or more CFM; completely AGA approved.

For all the facts write: TUCK-AIRE FURNACE COMPANY 2045 Evans Avenue • San Francisco 24, Calif.



HARRIS Stainless Steel FLOATS

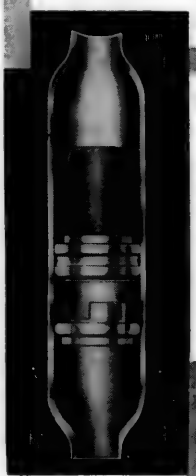
Write for Catalog

ARTHUR HARRIS & CO.
Established 1874

206 N. Aberdeen St.
Chicago, Ill.

The Only SPUN END CHECK VALVE & STRAINER COMBINATION

MAGNI-CHEK by WATSCO



U.S. PAT. NO. 2,646,071

A positive closing — non-electric magnetic check valve. The spun end copper Magni-Chek valve is specifically designed for split systems and heat pumps. A lifetime magnet controls a floating disc which is drawn to a positive closed position upon equalization of pressures. Magni-Chek can be soft or hard soldered into hermetically sealed systems, in any position. Features full port opening — no pressure drop.

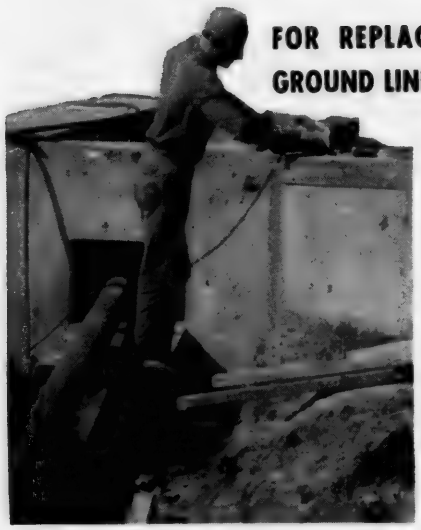
Available with or without built in monel strainer, in the following sizes: 1/4", 5/16", 3/8", 1/2", 5/8", and 3/4".

Special inlet and outlet connections can be made to your specification.

See your wholesaler or send for our catalog Dept. V-10

WATSCO INC.
1020 E 15th STREET · HIALEAH FLORIDA

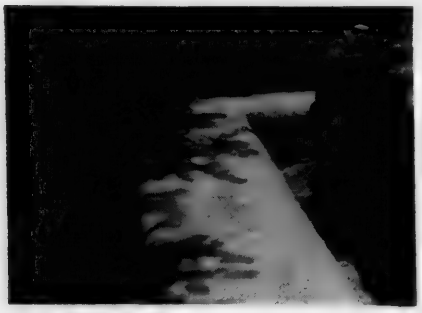
FOR REPLACEMENT OF EXISTING UNDERGROUND LINES AND FOR NEW CONSTRUCTION



Concrete "sidewalk" set to line and grade affords accurate alignment for 8" steam pipe.

Glass fiber block-out at loop entrance provides positive void space for lateral movement of piping.

Pipe loop leg will move without restraint within inverted metal pan block-out.



Completed expansion loop enclosed with watertight membrane ready for backfill.

"Z"crete BRAND

INSULATING CONCRETE CONDUIT is the ANSWER! at Eastern Washington College

MECHANICAL CONTRACTOR: James Smyth Plumbing & Heating, Spokane, Washington

CONSULTING ENGINEER: H. Jack Reeves, Spokane, Washington

CTC CERTIFIED CONTRACTOR: Vermiculite Contractors, Inc., Seattle, Washington

Recent underground work on the campus of Eastern Washington College, Cheney, Washington, called for the installation of 2100 feet of new high-temperature steam distribution lines, expanding the capacity of the system served by existing lines and extending lines to areas of new construction. "Z"crete insulating Concrete Conduit was selected for performance and permanence, and the assurance of recognized competence and integrity contributed by the CTC contractor, Vermiculite Contractors, Inc., who assumed responsibility for installation.

The advantage of field fabrication afforded the flexibility to work around unanticipated underground obstructions and permitted minor changes in alignment with a minimum of delay and expense. Drainable, driable "Z"crete Insulating Concrete Conduit with its tough, temperature stable watertight membrane enclosure is increasingly the choice of consultants and contractors for soil conditions similar to those at Cheney where standing water in spring and fall, and irrigation of grounds during the summer, subject the underground system to the hazards of water penetration.

There's a Certified CTC Contractor near you familiar with your soil and ground water conditions and expert in both counsel and installation of the "Z"crete brand system matched exactly to your requirements. Let us put you in touch with him now. There's no obligation, of course.

Send for **BULLETIN NO. 36** including the name of your nearest contractor

CONCRETE THERMAL CASINGS, INC.

2107 North 34th Street, Seattle 3, Wash.

3020 Grant Street, Evanston, Ill. / One East 42nd Street, New York 17, N.Y.

Briefly Stated

(Continued from page 148)

NEW REPRESENTATIVES

CONNER ENGINEERING CORP., Danbury Conn., manufacturers of air distribution and air purification equipment, appointed three new sales representatives: L. E. Schulein Co., Chicago to represent the company in Northern Illinois and Northwestern Indiana; Reube O. Emery and Associates, Nashville, Tenn., for Western Tennessee; and Wahl Engineering Sales Co., Phoenix, for the whole of the state of Arizona. . .

THE DALE WEATHERMATIC CORP., Nashville, Tenn., was named distributor for BRYANT MFG. CO. Its territory comprises the whole state east of the Tennessee River with the exception of the counties surrounding Chattanooga. In two other territorial changes, Bryant appointed a salesman to serve Lake and Porter Counties near Hammond, Ind. The balance of that territory will be handled by the Fort Wayne and Indianapolis distributors, the company said. . .

EDWARDS ENGINEERING CORP., Pompton Plains, N. J., manufacturers of packaged heating and cooling equipment, has appointed C. C. Patterson and R. L. Lesko as salesmen for its Grand Rapids and Detroit territories respectively. . .

GENERAL BLOWER CO., Morton Grove, Ill., manufacturer of industrial air and material handling equipment, appointed FAN SPECIALISTS OF NEW HAMPSHIRE, Bedford, N. H., as its representative for Maine, New Hampshire and Vermont. . .

PACIFIC PNEUMATICS, La Mirda, Calif., manufacturer of components for pneumatic systems, was appointed Southern California sales representative for Lehigh Fan & Blower Div. of Fuller Co. Sales territory includes all of Southern California up through the counties of San Luis Obispo, Fresno, Madera and Inyo. . .

PERSONNEL CHANGES

Thomas E. Kelly was promoted to manager of THE TRANE CO., New York City sales office. Mr. Kelly joined Trane in 1950 and was assigned as sales engineer to the New York City office. . .

Members of the Southern California refrigeration and air conditioning industry paid special tribute recently to L. P. "Jake" Jacobsen of YORK CORP. on the occasion of his leaving to assume a higher post with his company in Cleveland, Ohio. Mr. Jacobsen is widely known and highly respected for his efforts on behalf of the refrigeration and air conditioning industry both on the local and national level.

Fred Manget was promoted to manager of the Eastern Sales Region of THE TRANE CO., La Crosse, Wis. Mr. Manget joined Trane in 1948. . .

Donald Braden was promoted to field sales manager, Hydronic Accessories Dept., BELL & GOSSETT CO., Morton Grove, Ill. Mr. Braden, who joined the company a year ago as assistant manager of the market development division, will be responsible for sales to wholesalers, national account distributors and original equipment manufacturers.

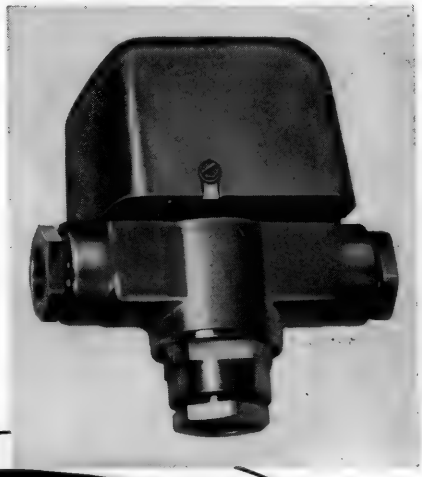
RESEARCH PRODUCTS CORP., Madison, Wis., manufacturers of air filters and humidifiers, has added Dean E. Pieringer to its sales staff in the capacity of District Salesman. Mr. Pieringer has been associated with the company for the past several months in the home office in Madison. He will serve the Chicago area and will headquarter in Park Forest, Ill. . .

MINNEAPOLIS-HONEYWELL COMMERCIAL DIVISION has appointed two new product sales managers: William Wray for the Data Center

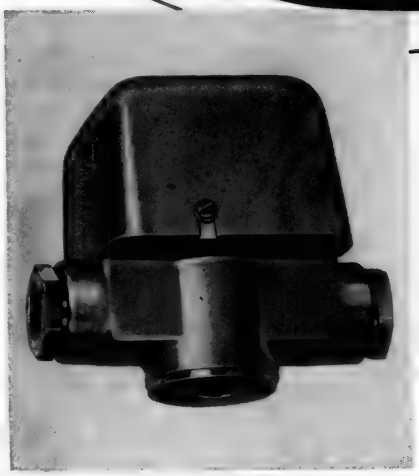
Now available * *for* **FAN-COIL UNITS**

Reliable
Quiet
MOTOR
OPERATED
VALVES

3-WAY MODEL



ERIE motortrol
SERIES 436A



2-WAY MODEL

- quiet operation
- low cost
- compact
- easiest installation
- works in any position
- cannot plug or foul
- high flow capacities
- simple design
- 100% shut-off
- "fail-safe" operation

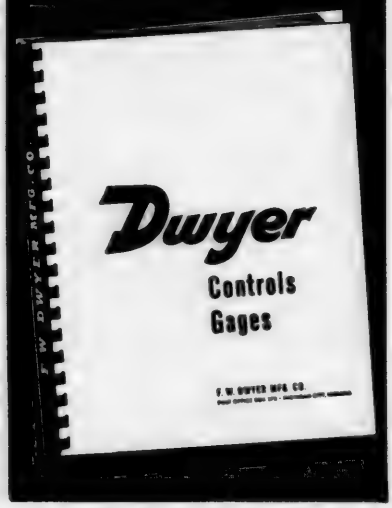
*WRITE FOR BULLETIN 210

ERIE MANUFACTURING CO.

TRADE NAMES: MOTORTROL • ELECTROL • TIME-O-FLOW • TIME-O-GAS • PROGRAMMATIC • ELECTROMATIC

Milwaukee, Wisconsin and (Canada) Ltd., Stouffville, Ontario

For the latest in Gages...Controls



NEW

Dwyer

INSTRUMENT MANUAL

Contains:

Illustrations and complete details of Dwyer
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- manometers
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- air filter gages
- pitot tubes
- pressure actuated switches
- flowmeters
- combustion testing instruments

Diagrams
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Briefly Stated

and building automation, and Robert Buzby for clocks and fire alarms. . .

AMERICAN - STANDARD CONTROLS DIV., Detroit, manufacturers of valves, controls, and indicating instruments for gases, fluids, and electrical energy, promoted two veteran sales executives to broader responsibilities in the marketing department. Sylvan E. Leinwand, sales manager for TyniSwitch snap-action precision switch products since January, 1960, was named product planning manager — electromechanical devices. Joseph F. Page, associated with the division in various sales capacities for the past 25 years, succeeds Mr. Leinwand as sales manager for TyniSwitch products.

SPORLAN VALVE CO., St. Louis, has promoted Frank L. Vaugn and Alan Owens to district managers in its field sales organization. Mr. Vaugn will head the new district office in Birmingham. The district covers parts of Tennessee, Louisiana, and all of Mississippi, Alabama, and Florida, including the Tampa territory office headed by John Adams. Mr. Owens will headquarter in Washington, D.C. His newly created district includes part of West Virginia, Tennessee, and all of Virginia, North Carolina, Maryland, South Carolina and Georgia, including the Atlanta office staffed by Grant Brown.

* * *

William R. Stockwell, 86, former vice-president and general manager of WEIL-MCLAIN CO., died July 29 in New York City. For many years Mr. Stockwell was a leader in the hot water and steam heating industry. He retired in 1949 after more than fifty years service in the industry. He was one of the organizers of the INSTITUTE OF BOILER & RADIATOR MANUFACTURERS, later serving as chairman and director, and was an honorary lifetime member of ASHRAE.

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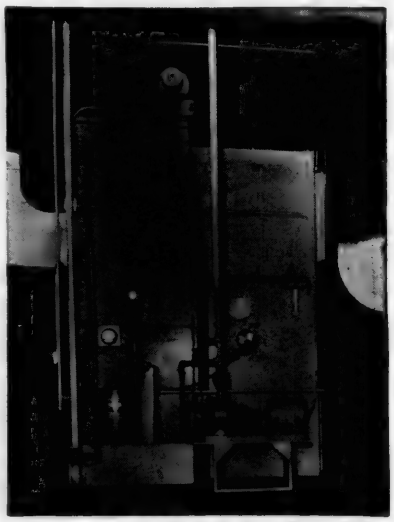
Air Conditioning



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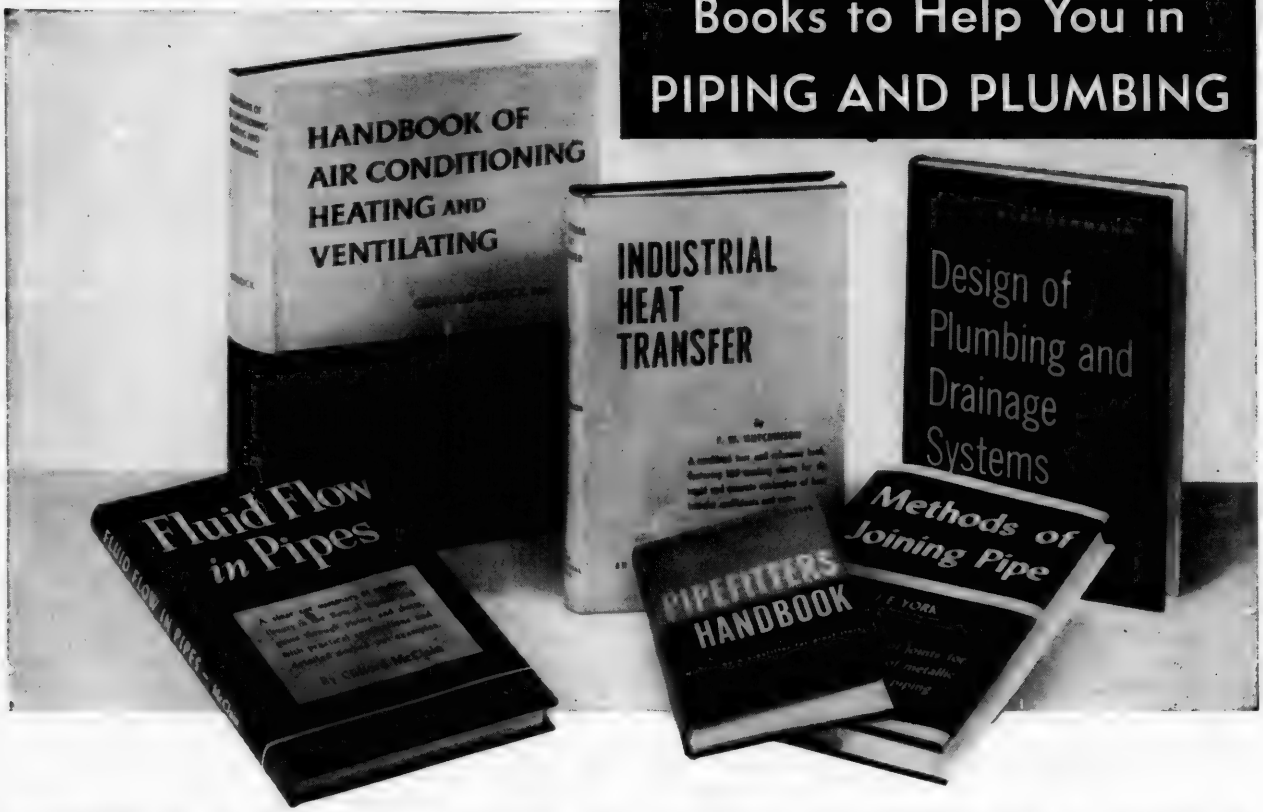
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BOOK REVIEWS

Publications abstracted in this department should be ordered direct from publisher.

IONIZED AIR—Claims that mental attitude and ability to perform tasks are affected by breathing excesses of positive and negative ions in the atmosphere are challenged by an Air Force study of the effects of ionized air on human behavior. Groups of 50 male university students were subjected to three tests; the first required a subject to make rapid decisions which involve close attention to detail; the second required relatively infrequent responses to near-threshold stimuli. Both tests are very sensitive to motivation.

The third test consisted of check-off lists to reveal the mental attitude of subjects at varying levels of ionization. All tests were administered in a room wherein five different ionic levels were controlled. Conditions ranged from a high excess of positive ions through a medium excess; low ion (neutral); medium negative and low negative. Neither the attitudes nor the abilities of subjects to perform tests administered were affected by ion levels, according to the research. Previous reports of behavioral effects of air ionization said such effects occurred at levels simulated in the tests.

The Air Force study, entitled *A Study of the Effects of Ionized Air on Behavior*, by W. D. Chiles, Aerospace Medical Division, and J. M. Cleveland and R. E. Fox, Physics, Engineering and Chemistry Corporation, may be ordered (Order No. PB 171 600) from Office of Technical Services, Department of Commerce, Washington 25, D. C. Price is 75 cents.

PERFORMANCE OF BUILDINGS is the title of Publication 879 of the National Academy of Sciences-National Research Council, being the proceedings of a conference held as part of the 1960 Spring Conferences of Building Research Institute. Papers cover performance information needed by the architect, contractor, product manufacturer; and performance survey reports on commercial, office, industrial, residential, and institutional buildings. Available at $5 from BRI, 2101 Constitution Ave., Washington 25, D. C. Paper bound, 8½ x 11.

OIL BURNERS—The second edition of *Domestic and Commercial Oil Burners, Installation and Servicing*, provides a comprehensive reference of technical and practical material on domestic and commercial oil burners. The various types of burners and their parts are described, with information on their construction and how they operate. All steps in making burner installations are covered, from deter-

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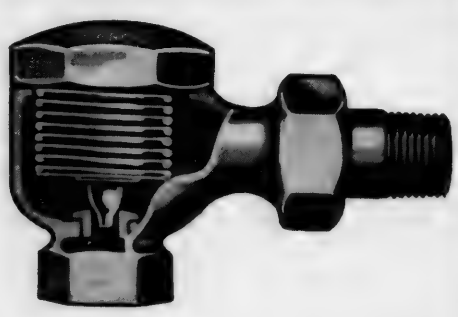
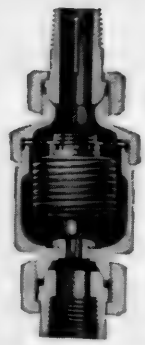


Sarco Type H Radiator Trap, angle pattern



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mining the gph rate for both new and conversion installations to putting in various types of control systems. The revised edition provides full information on commercial burners which were not covered in the first edition. In addition, the book has been brought up-to-date to cover new types of burners and their accessories, advances in controls, and improved installation and servicing procedures. The author, Charles H. Burkhardt, is managing director and secretary-treasurer of Oil-Heat Institute of America. With 416 pages, 6 x 9, and 358 illustrations, the price is $9.00 from McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York 36, N. Y.

"REFRIGERANT PIPING DATA", a 62-page book designed to serve as a guide for the proper sizing of refrigerant piping for the common types of refrigerants, has been published by the Air-Conditioning and Refrigeration Institute, 1346 Connecticut Ave., N. W., Washington 6, D.C.

In presenting the data included in the book, which includes data for Refrigerant 12 (dichlorodifluoromethane), Refrigerant 22 (monochlorodifluoromethane) and Refrigerant 717 (ammonia), ARI points out that "since each job has its own problems and peculiarities, and must be individually designed, this booklet should be used primarily as a guide."

Information presented includes tabular and chart data not available elsewhere. Supplementing the ready-reference information are discussions, with suitable references, of the basis for refrigerant piping design including instructions, with worked-out examples for application of the tables and charts.

Announcement of publication of the book was made several months prior to its actual availability, and response from the industry has already been above expectations, both in terms of acceptance by engineers and of orders for the publication, ARI states.

The book is available from ARI at $3 per copy.

AEC ACCESS PERMITS—The Atomic Energy Commission has published a 12-page revision of the pamphlet *"Questions and Answers on U.S. Atomic Energy Commission Access Permits", TID-4558 (3rd Rev.)* which is available without charge from the Office of Technical Information Extension, U.S. Atomic Energy Commission, P. O. Box 62, Oak Ridge, Tenn. The pamphlet is designed to answer the most frequently-asked questions raised by organizations and individuals engaged in nuclear science or industrial work regarding the Access Permit Program. The publication has been revised to include the most recent changes in the program. The Access Permit Program provides a method for making available to the research and scientific field certain types of classified data.

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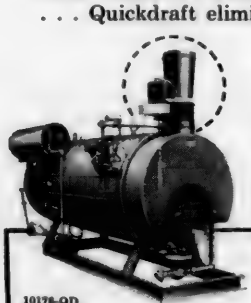

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COMING EVENTS

Where listed, names or titles of individuals are those from whom further information is available.

CORROSION ENGINEERS CONFERENCE—Three regional conferences of the National Association of Corrosion Engineers will meet this Fall. For information write T. J. Hull, Executive Secretary, 1061 M & M Building, Houston, Texas.
South Central Region, Houston, Texas. . . **OCTOBER 24-26, 1961.**
Northeast Region, New York, N. Y. . . . . **OCTOBER 30-NOVEMBER 2, 1961.**
Southeast Region, Miami, Florida. . . . . **NOVEMBER 27-DECEMBER 1, 1961.**

INDUSTRIAL HYGIENE FOUNDATION—The 26th annual meeting of the Industrial Hygiene Foundation of America Inc. will be held at the Mellon Institute, 4400 Fifth Avenue, Pittsburgh 13, Pa. Dr. H. H. Schrenk, Managing Director, 4400 Fifth Avenue, Pittsburgh 13, Pa. . . . . **OCTOBER 25-26, 1961.**

CONSULTING ENGINEERS COUNCIL—Semi-annual meeting of CEC Board of Directors, Miami Beach, Fla. Larry N. Spiller, executive secretary, 322 Reisch Bldg., Springfield, Ill. . . . . **NOVEMBER 2-4, 1961.**

NATIONAL WARM AIR—The 48th Annual Convention will be held at the La Salle Hotel, Managing Director, James M. Martin. National Warm Air Heating and Air Conditioning Association, 640 Engineers Building, Cleveland 14, Ohio. . . . . **NOVEMBER 6, 1961.**

BRI FALL CONFERENCES—Building Research Institute Spring Conferences, Shoreham Hotel, Washington, D. C. BRI, 2101 Constitution Ave., Washington 25, D. C. . . . . **NOVEMBER 14-16, 1961.**

NEMA MEETING—The 35th annual meeting of the National Electrical Manufacturers Association will be held at The Plaza Hotel, New York City, N. Y. For information write Russell Gingles, Director of Public Relations, 155 East 44th Street, New York 17, N. Y. . . . . **NOVEMBER 16, 1961.**

PLUMBING BRASS MEETING—The annual meeting of Plumbing Brass Institute at the Savoy-Hilton Hotel, New York City, N. Y. For information write: Arthur L. Weldy, Shea Expositions Corp., One Gateway Center, Pittsburgh, Pa. . . **NOVEMBER 27-29, 1961.**

CHEMICAL INDUSTRY EXPOSITION—The 28th Exposition of Chemical Industries will be held at the New York Coliseum, under the management of the International Exposition Co., 480 Lexington Ave., New York 17, N. Y. E. K. Stevens, manager. . . . . **NOVEMBER 27-DECEMBER 1, 1961.**

BHC COUNCIL MEETING—The sixth annual meeting of the national Better Heating-Cooling Council will be held at the Hotel Delmonico, New York City, N. Y. For information write Ray Schumack, 250 Park Ave., New York 17, N. Y. . . . . **DECEMBER 18-19, 1961.**

ARI EXPOSITION—Air Conditioning and Refrigeration Institute, 12th Exposition, Pan-Pacific Auditorium, Los Angeles. Information: George E. Mills, ARI Show Director, 1346 Connecticut Ave. N.W. Washington 6, D. C. . . . . **FEBRUARY 12-15, 1962.**

ELECTRIC HEATING SHOW—The Second National Electric House Heating Symposium and Exposition, sponsored by Electric House Heating Section, National Electrical Manufacturers Association, 155 East 44th Street, New York 17, N. Y., to be held at the Sherman Hotel, Chicago, Ill. Write Russell Gingles, NEMA director of public relations. . . . . **MARCH 19-21, 1962.**

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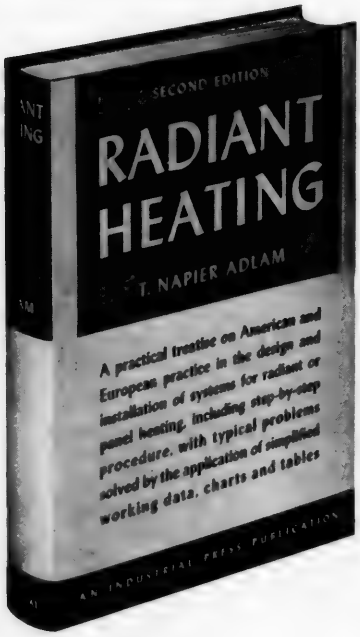
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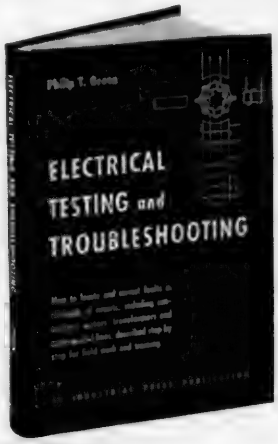

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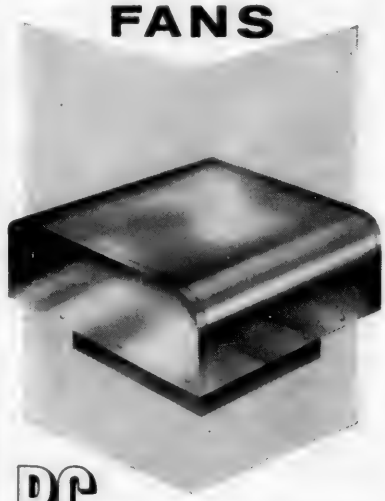

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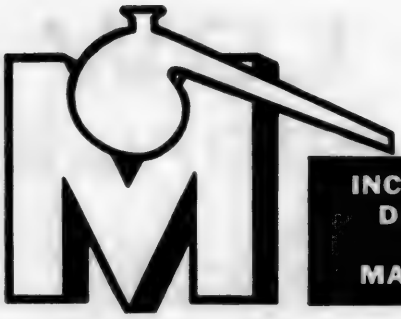

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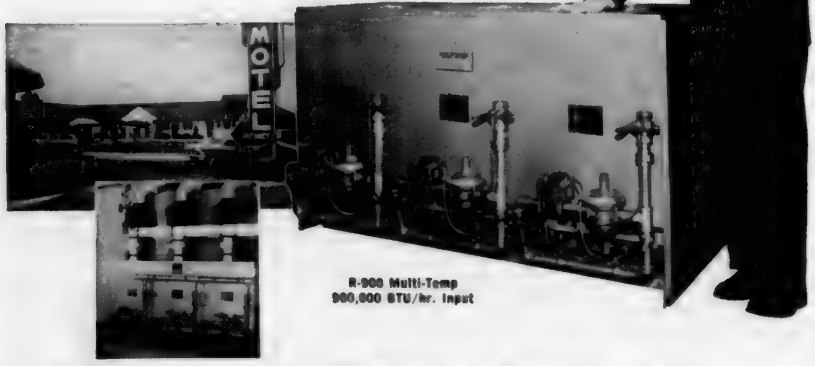

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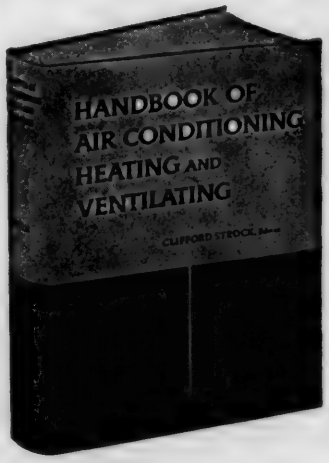

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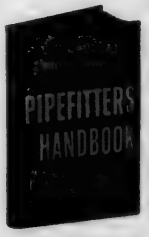

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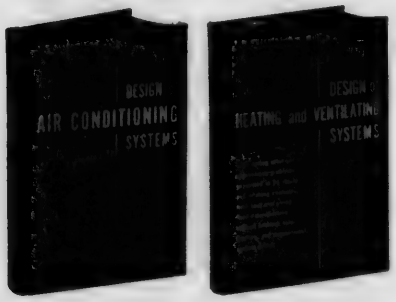

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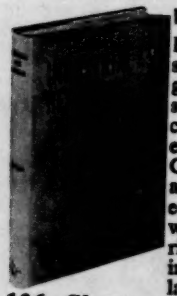

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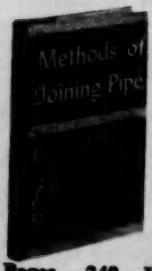

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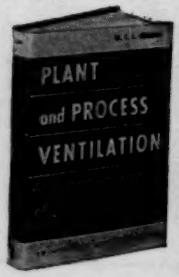

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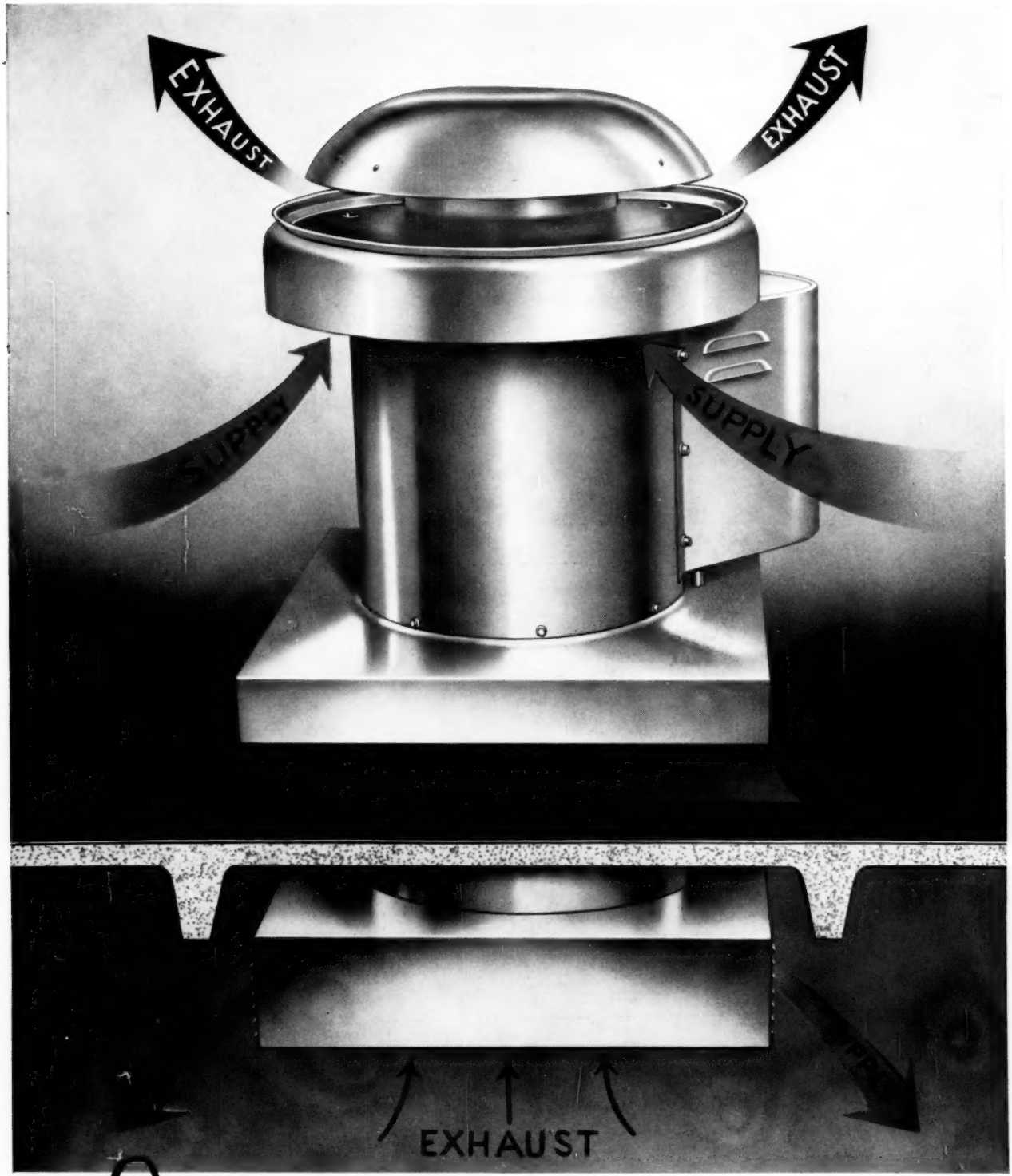

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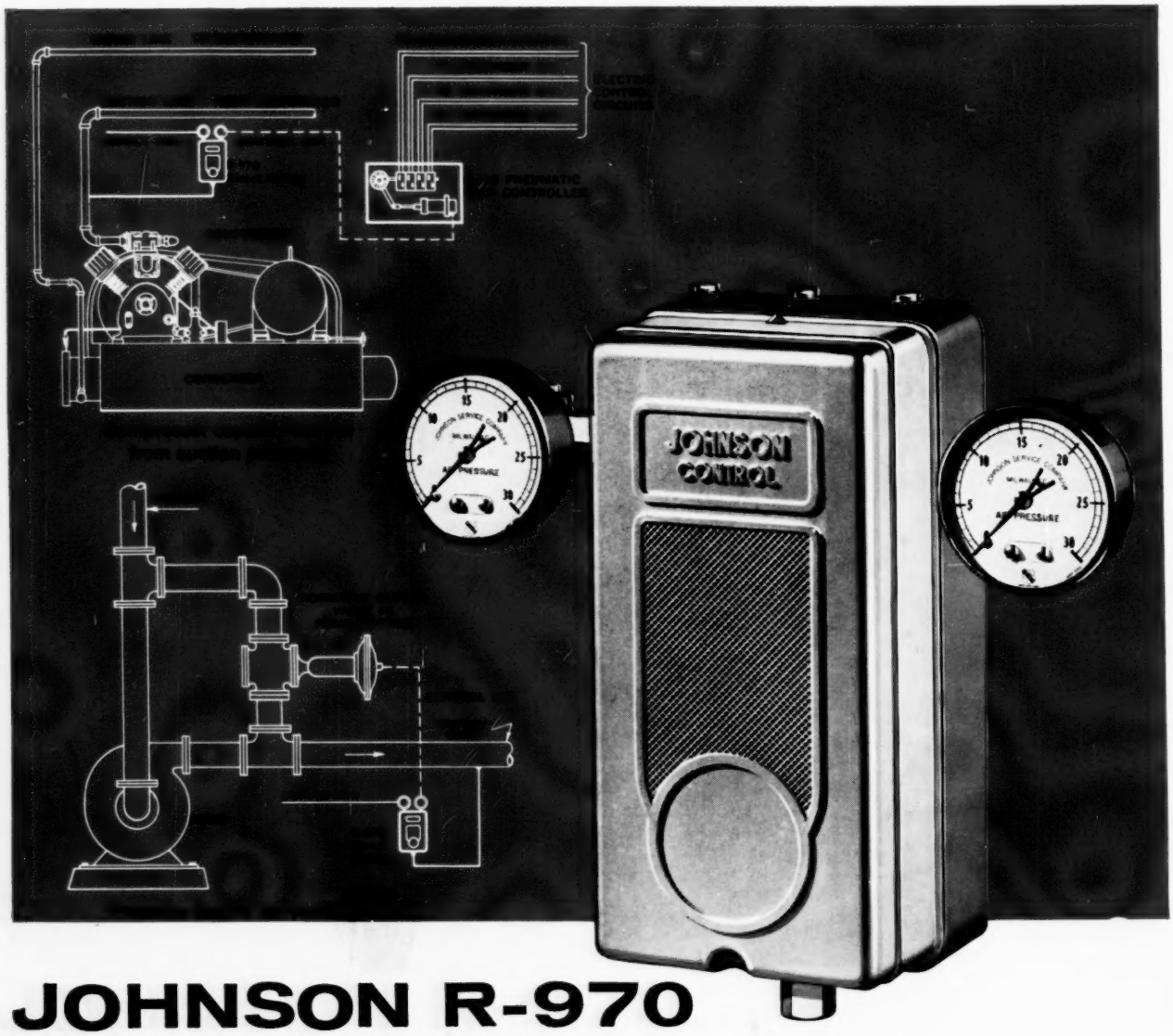

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